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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## THE BELL-BEUTTNER OPERATION WITH OVARIAN CONSERVATION OR GRAFTING<sup>1</sup>

By W. BLAIR BELL, B.S., M.D., F.A.C.S. (Hon.), LIVERPOOL, ENGLAND

P. tes. (O. t. tuc. i. Gynec. i. cy. Th. Un. ty. Obst. i. l. nd. Gy. scol. gic. i. S. g. n. Th. R. y. i. i. S. m. y. L. v. pool. H. F. l. w. Am. ca. Gynec. i. g. Soc. ty. fo.

THE day when the greatness of a surgeon was judged by the rapidity with which he could amputate a limb has long vanished over the western horizon. So also I trust will the time when the female genital organs are extirpated for comparatively innocuous lesions soon fade into oblivion. Those of us in the old world who protest against ovarian and uterine nihilism and are endeavouring to set an example of conservation of function—and there are many disciples of this faith among my younger colleagues in Great Britain—turn with hopeful eyes to America. We believe that such scientific idealism must surely appeal to the surgeons of a continent on which so much has been done and is being done to purify surgery and to lead practitioners of the surgical art to temper surgical justice with physiological mercy.

Can we not imagine such an one as John Hunter with his profound interest in the relation of structure to function, if he lived today leading a crusade of restraint? We, his successors with our accumulated and therefore intimate knowledge of biology and pathology, should have only one thought and that is how in every necessary operation not connected with malignant disease we can ensure the removal or treatment of diseased structures without which the symptoms cannot be cured with conservation as far as possible of function (5).

I believe that the operation I am about to discuss is a measure that conforms with that principle when used in properly selected cases. I wish particularly to emphasize the qualification properly selected cases for nothing brings disrepute upon surgical procedures so much as routine and ill considered application.

### RELATION OF THE CHARACTER OF THE LESIONS PRODUCED BY INFECTION TO THE OPERATIVE PROCEDURE ADOPTED

In ascending infections of the female genital tract lesions may be produced throughout from the external genitals to the pelvic peritoneum and the character of these depends not only on the organism responsible for them but also on the time of infection especially in relation to menstruation, pregnancy and the puerperium and on the general resistance of the patient.

I do not think that it is necessary in this short communication to do more than to say in regard to these matters that some infective lesions of the genitalia tend to recover naturally or are not difficult to cure by simple non-operative measures. Occasionally salpingostomy or pneumatic dilatation alone or combined with a modified Gilliam operation may suffice. This has been clearly demonstrated by the statistics of Holtz (8) and others.

The inflammatory lesions for which the Bell Beuttner operation is indicated are those

<sup>1</sup> R. d. before th. O. x. i. Congress. i. th. Am. ca. Coll. g. Surg. Phil. d. 19th. Oct. be. 6-5. 1915

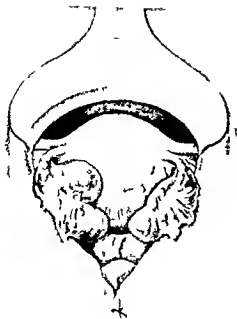


Fig. 1

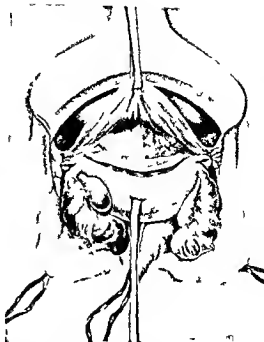


Fig. 2

which cause irreparable damage of the tubes and possibly ovaries and affect the fundus uteri but less severely. Such lesions are chiefly produced by the gonococcus. Streptococcus is usually less destructive for reasons I have discussed elsewhere (4, 5).

It is an essential condition that the infection be in the chronic stage at the time of operation (5).

In gonorrhoeal cases it is often advisable for the surgeon to amputate or treat the cervix in which the gonococcus finds an ideal habitation before proceeding with the major operation and this is especially necessary when that structure has been lacerated by child birth.

Lesions of the fundus uteri due to infection cause menorrhagia or epimenorrhagia. The other symptoms from which the patient may seek relief are those associated with chronic salpingo oophoritis—constitutional ill health, dysmenorrhoea, dyspareunia, abdominal pain and the rest.

In the absence of menorrhagia the fundus is rarely found to be bulky and seriously in-

fectured and in such cases it is sufficient to excise the pyosalpinges present together with a wedge shaped portion of the cornua uteri. If the uterus be retroverted it may be suspended in the way mentioned.

In other cases the whole uterus may be very badly affected or the woman may be approaching the menopause and in these circumstances hysterectomy with removal of the adnexa may be advisable.

It is remarkable in how many cases I have performed the minor or major procedures reserving the intermediate operation—the Bell Beuttner—for the lesions I have mentioned namely irremediable injuries of the tubes and ovaries with definite infection of the fundus uteri. In consequence of the care employed in the selection my statistics do not comprise a large number of operations.

The question of conservation of the ovary in the normal position is not always an easy one to decide. There are those I know who never have any difficulty in settling the matter—they always remove the ovaries on the least provocation.



Fig. 3

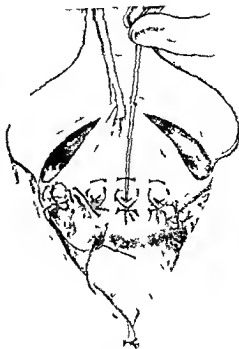


Fig. 4

In general I think it is better not to leave an ovary in the pelvis when there is any likelihood that there has been interference with the blood supply sometimes however, it is possible safely to do so. I have dealt with this matter in a paper on ovarian grafting published in *SURGERY, GYNECOLOGY AND OBSTETRICS* (December 1925 p 706) and shall not therefore go into the problem here beyond saying that in women under 40 years of age an ovarian graft should be made if both ovaries are removed from their normal connections.

#### TECHNIQUE OF THE BELL-BEUTNER OPERATION

I must first make it clear that in my original publications (2, 3) the technique adopted was not so elegant and satisfactory as the almost immediate improvements have now made it (4, 5).

Further although in the United States the operation has been called the Bell-Beutner operation it should be understood that in this designation the similarity of principle (6, 7) rather than that of technical detail is implied. Moreover although I was unaware of

the fact, and devised the operation quite independently there is no doubt that Professor Beutner's first communication (6) preceded mine.

The following are the chief points in the method I practice:

1 As in dealing with any case of salpingitis it is important for the surgeon after separating adhesions to omentum and bowel if these be present to free completely the adherent tubes and ovaries and also the uterus if it be bound down in a position of retroversion (Fig. 1).

2 The infundibulopelvic and round ligaments are ligated together on both sides if the ovaries are to be removed and an additional ligature is tied round each infundibulopelvic ligament as a measure of safety (Fig. 2).

3 If one ovary can be retained in position the mesosalpinx of the same side is divided as close to the affected tube as possible. Vessels are caught in forceps and ligated subsequently. A ligature placed around the ovarian and round ligaments includes the terminal anastomotic branches of the uterine artery on this side (Fig. 3).

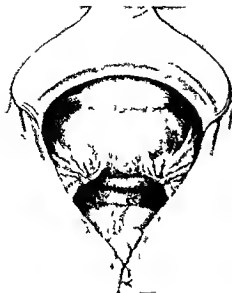


FIG 5

4 After the ligation of vessels mentioned according to the intention of the surgeon to leave an ovary *in situ* or not as described in the preceding paragraphs a transverse flap of peritoneum of the uterovesical pouch is raised and the uterine arteries on either side are ligated at a level about one half or three quarters of an inch above the internal os uteri (Fig 2)

The entire blood supply of the parts concerned is thus arrested, and the operation should be almost bloodless

5 The ovaries and tubes are cut free on either side—unless the tube on one side has already been detached leaving an ovary in position—up to the lateral aspects of the uterus above the ligatures placed on the uterine arteries

6 A transverse wedge shaped portion of the fundus is now excised by means of anterior and posterior incisions (Figs 2 3 and 4)

7 The V shaped raw area left in the uterus with the lower part of the uterine cavity showing in the angle is closed by means of the mattress and over suture which I employ so frequently in operations involving suture of the uterus and of the vaginal walls and which is best effected with a Reverdin needle The

mattress stitches when tied bring into apposition the deeper parts of the uterine wound and the over stitches made with the long ends of the threads left after the mattress stitches have been tied close effectively the edges (Fig 4)

8 The pedicles on either side in which are contained the round and infundibulopelvic ligaments or on one side the round ovarian ligaments are fixed by means of a suture fairly high on the back of the utriculus (Fig 4) By this means the small uterus is kept forward an important consideration if there be raw surfaces in the pouch of Douglas where adhesions have been separated

9 The flap of peritoneum which was raised from the uterovesical pouch is now brought over the utriculus and sutured to the posterior wall In this way the line of suture at the summit of the small uterus is completely covered In a like fashion with lateral sutures the attachments of the pedicles to the posterior surface of the uterus are covered smoothly with peritoneum (Fig 5)

This last detail of technique is most important for intestinal adhesions to the line of suture in the uterus would be most difficult to prevent if a covering of peritoneum were not used

Figures 6 and 7 are photographs of specimens after removal Figure 6 shows a double pyosalpinx with ovaries and the wedge shaped portion of the fundus excised In this case an ovarian graft was made

Figure 7 shows a left pyosalpinx and an occluded tube on the right side In this case it was possible to retain the right ovary

The mortality rate of 2.3 per cent may be regarded as very satisfactory when it is remembered that the operation is only concerned with a serious type of infection and that the cases include those of puerperal origin

In Beuttner's clinic there were 5 deaths in the first 40 cases—a mortality rate of 12.5 per cent As the deaths in the Geneva clinic were chiefly due to peritonitis it appears that care could not have been taken to operate only when the condition was chronic

It will be observed that functional results have been obtained in a large number of



Fig 6

## CLINICAL RESULTS

A	Number	Per cent
Cases in which the Bell Beutner operation was performed together with ovarian grafting	108	
No after history obtainable	30	6
Mortality	3	
Operation too recently performed for result to be estimated	0	
Number of cases considered	66	68
Menstruation occurred	15	
Menopause was averted	51	
Probable number in which absence of menstruation was due to failure of graft	15	22
Successes		

B	Number	Per cent
Cases in which the Bell Beutner operation was performed and an ovary retained <i>in situ</i>	19	
No after history obtainable	9	0
Mortality	0	
Operation too recently performed for result to be estimated	1	
Number of cases considered	9	89
Menstruation occurred	8	
Menopause occurred indicating ovarian insufficiency	1	
Successes		100

TABLES A AND B SUMMARIZED

	Number	Per cent
Total number of cases	127	
No after history obtainable	39	23
Mortality	3	
Operation too recently performed for result to be estimated	10	
Number of cases considered	75	90
Successes		

cases. Yet whereas we should consider the absence of menopausal symptoms as a positive functional result in the presence of a retained or grafted ovary when menstruation is impossible because the uterus has been removed in this particular procedure the whole object is to secure the persistence of menstrua-



Fig 7

tion without which many women do not consider themselves normal as I could illustrate with actual instances had I time to discuss the psychology of women on this matter. So it is necessary to classify the case in order to show when the absence of menstruation has been due to failure to function of the grafted tissues. This has occurred in 7 per cent of all my cases of ovarian grafts.

In one instance the menopausal symptoms occurred when an ovary had been retained.

It is obvious from the statistics that the percentage of successes is greater when an ovary is retained than when an ovarian graft is made.

## CONCLUSIONS

1. The preservation of the genital functions in the female even though conception be impossible is a surgical ideal to which we should strive to attain whenever operations on the female genitalia may be necessary.

2. It is possible by the procedures described combined with ovarian retention or grafting to obtain highly satisfactory results—that is 90 per cent of successes—in a type of lesion which has usually been considered amenable only to eradication measure. Some what better results are obtained if an ovary can be retained but this is only possible in about 15 per cent of all cases in which the Bell Beutner operation is indicated.

I am much indebted to Dr. S. B. Hend for the trouble he has taken in compiling the statistics of the operation and after histories of the patients.

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## CHRONIC PELVIC INFECTIONS

DEDUCTIONS RESULTANT FROM A COMBINED CLINICAL AND LABORATORY STUDY<sup>1</sup>

By ARTHUR H. CURTIS, MD, FACS, CHICAGO

F. m. th. Gyn. log. Pers. d. p. th. log. IL. hor. t. ry. 1 St. L. k. H. p. tal

**N**UMEROUS modern contrivances have added materially to the world's sum total of comfort and happiness. Unfortunately some of them have also introduced serious complications. The automobile for example has facilitated murder and banditry, has served to increase extravagance and wastefulness and has become a death dealing weapon in the hands of the reckless.

The scalpel and scissors and the uterine curette have likewise sometimes brought sorrow rather than relief. Gynecologists remember with chagrin the former tendency to need less sacrifice of healthy ovaries. We have learned also from the school of experience the folly of operation upon patients who suffer from acutely infected tubes. Soon we hope the curette will no longer be used to stir up postabortive infection. Eventually women seriously ill with childbed fever may be permitted to recover spontaneously, spared the morbidity and mortality which inevitably accompany radical surgical intervention.

In the few minutes at my disposal I wish to picture the present status of our knowledge of certain pelvic infections; this may permit me to point out further modifications in the indications for gynecological surgery. Of necessity the deductions presented may be somewhat at variance with generally accepted views if seemingly unwarranted. I beg your indulgence.

## CHRONIC LEUCORRHOEA

The subject of leucorrhoeal discharges has long remained a mystery. Until comparatively recent times leucorrhoea was supposed to originate chiefly in the uterus. In fact a tour of the leading gynecological clinics a dozen years ago revealed that curettage for relief of 'chronic endometritis' was the most frequently performed surgical procedure.

Laboratory study and clinical investigation of patients with leucorrhoea have contributed

considerable information. Although much of this subject still remains unsettled we have learned that chronic discharges arise chiefly from the cervix and from glandular pockets in the vicinity of the urethra. It has also been found that approximately 30 per cent of all patients with chronic purulent leucorrhoea are carriers of virulent streptococci. This means that 1 out of every 3 patients with persistent purulent vaginal discharge is a candidate for spontaneous postpartum infection. (This is particularly true of those who develop at labor, cervical lacerations which extend upward into the cellular tissues of the broad ligaments.) Likewise operation by the vaginal route upon these leucorrhoeal carriers of streptococci is accompanied by more than the usual risk of postoperative pelvic peritonitis.

In contrast I wish at this time to point out the fallacy of overemphasis of cervical infections as foci for arthritis and other serious systemic disturbances. It is true leucorrhoea may be cured by removal or destruction of the diseased cervix; also a considerable number of patients may be thus relieved of sterility. But systemic infection from chronic cervicitis appears to be unusual and we must be guarded in forecasting a notable improvement in general health as the result of plastic surgery upon the diseased cervix.

## THE ENDOMETRIUM

In 1918 there was reported a combined bacteriological and histological study of the endometrium. This investigation of the thoroughly ground endometrium from 118 uteri obtained by hysterectomy indicated that chronic infection of the lining of the uterus is unusual. Since 1918 approximately 15 per cent of all uteri removed have been subjected to similar study. These more recent results are confirmatory of previous evidence. It follows that supravaginal removal of the chronically diseased body of the uterus is



Fig 1 Acute endometritis a relatively frequent occurrence after diagnostic curettage. Hysterectomy should preferably be performed at the time of curettage or postponed until subsidence of the inflammatory reaction.

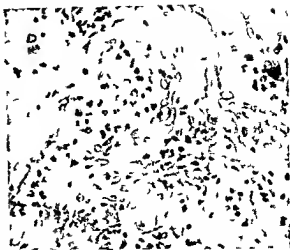


Fig 2 Further evidence of infection after curettage. Endometrium from a uterus which had been curetted one week previous to hysterectomy.

a clean procedure iodization or cauterization of the uterine stump is ordinarily superfluous.

On the contrary a lesser group of these cases deserves special mention. We have gradually accumulated uteri which had been curetted or packed several days previous to hysterectomy. Many of these reveal bacteria in cultures of the ground endometrium and histological evidence of infection. It would appear that extensive instrumentation of the uterine cavity introduces the possibility of temporary acute endometritis. Since recognition of this complication we have followed the clinical course of all available patients known to have been subjected to removal of the fundus some days after the uterus had been packed or curetted. These individuals reveal a considerable incidence of postoperative peritoneal infection.

Furthermore study of patients after criminal abortion yields corroborative evidence. The abortionist can enter the clean uterus almost with impunity. But if he fears the fetus has not been removed and ventures to invade a second time he stirs up bacteria introduced at the first instrumentation. High morbidity or mortality after abortion is almost pathognomonic of repeated invasion or instrumental perforation of the uterus.

#### THE FALLOPIAN TUBES

Study of the fallopian tubes revealed long ago that gonorrhoea attacks the tubes from within whereas streptococcus infection of the tubes is but a part of more widespread streptococcal pelvic infection.

*Gonorrhoeal tubes* For some time it has been known that the gonococcus does not live long in the lumen of the tube. It has always been assumed that the bacteria remain viable in the deeper tubal wall and that chronic infection is thus maintained.

In a search for dormant infection cultures made of over 200 thoroughly ground fallopian tubes revealed that it is almost never possible to obtain the gonococcus longer than 2 weeks after disappearance of fever and leucocytosis. Upon completion of the major portion of this work in 1921 we came to the conclusion that gonorrhoeal salpingitis is a self limited process persistently active gonorrhoea of the tubes appeared ascribable to recurrence of infection from without rather than to chronic infection. Furthermore it appeared also that male carriers are not the only source of tubal reinfections gonococci remain long viable in the lower genital tract and fresh infection of the tubes may result from traumatism of the cervix or from the passage of vaginal douches upward through the cervical canal.



Fig. 3. Mother and son, a demonstration of the value of conservative treatment. This patient had acute salpingitis after marriage and was treated conservatively. Operation was performed 4 years later for relief of pelvic adhesions and sterility. Left hydrosalpinx was removed, the adherent occluded right tube was released, the fimbriae opened and air forced through the lumen of the tube into the uterine cavity. Pregnancy occurred within 5 months. A second baby expected soon.

It had previously been our custom to remove notably diseased tubes of service patients after complete subsidence of acute infection. Now (in 1911) we began to avoid operation. Patients were isolated from their sources of infection, were forbidden to take douches and were treated expectantly. As a result, it was found that those who suffer from only one attack of salpingitis rarely have severe symptoms or reveal extreme pathological changes. Even those who have been repeatedly infected tend to ultimate recovery if removed from consorts who are carriers of disease.

From bacteriological study combined with 5 years' conservative clinical experience we have concluded that operation upon fallopian tubes for eradication of gonorrheal infection is not often indicated. The infection disappears spontaneously if the patient is isolated from the source of her disease. Expectant care

eventuates in clinical recovery of the great majority of patients and is beneficial to those who must ultimately obtain operative relief. Surgery should usually be long delayed and reserved chiefly for sequelae such as adhesions, menstrual disturbances and sterility.

To those who would ask whether operation is not always indicated in patients with a history of repeated attacks, I would suggest that the most satisfactory management is conservatism, such for example as a gynecologist of today might observe in the care of his sister before resorting to surgical intervention.

It may be thought that women can not be persuaded to abstain from exposure to repeated infection. This is seldom true. The difficulty lies in the fact that we have overestimated the persistence of a single infection and have not sufficiently emphasized the danger of subsequent exposure. When a sufferer from salpingitis is frankly informed that she must choose between prolonged abstinence and surgical removal of the genitalia, conservatism wins. (Occasional indulgence later with sheath protection is a helpful compromise measure.)

**Streptococcus infection.** Streptococcus infection of the tubes, as previously stated, is but part of more widespread pelvic involvement. The complete picture may, however, closely resemble gonorrheal disease. A history of abortion, a persistent tendency to aching distress in the pelvis, a prolonged tendency to slight chills or low grade fever, are suggestive.

The tissues may yield bacteria for a long period of time. 6 months is fairly common; recovery of streptococci after 2 years is not infrequent; in one instance they were obtained 18 years after the initial infection.

Here too it seems best to operate only for complications or sequelae. When relief of symptoms demands intervention, 6 months is surely the minimum length of time to allow for subsidence of infection. If possible, operation should be postponed for 2 years or more.

When surgery is undertaken we believe that a more radical attitude toward removal of infected ovaries is indicated in streptococcal cases because there is considerable danger of recurrent infection. Drainage is occasionally

expedient even in the absence of pus and despite the fact that the use of drains in pelvic surgery is nowadays less in vogue

### CONCLUSIONS

1 Operation by the vaginal route, upon patients with chronic purulent leucorrhœa introduces an increased risk of postoperative streptococic pelvic peritonitis

2 The endometrium of the body of the uterus is nearly always free from bacteria. Supravaginal hysterectomy is therefore ordinarily a clean procedure

3 Mild infection of the endometrium is relatively frequent after diagnostic curettage. Hysterectomy should preferably be performed at the time of curettage or postponed until subsidence of the inflammatory reaction

4 Operation upon fallopian tubes for eradication of gonorrhœal infection is not often indicated because the infection tends to disappear if patients are isolated from consorts who are carriers of disease. Surgery should usually be long delayed and reserved chiefly for sequelæ such as adhesions, menstrual disturbances, and sterility

## HEPATIC FUNCTION IN HEALTH AND DISEASE<sup>1</sup>

BY CHARLES H. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

**S**MALL organs have often engaged the attention of great men but at the present time the liver, the largest organ in the body, is exciting the interest of many profound students

### HEPATIC FUNCTION IN HEALTH

*Metabolism in sugar.* The liver is not only the fuel storehouse of carbon in the form of sugar or glycogen from which store the blood sugar level is maintained but it is also the site where glucose is made from other materials. Although nearly an equal amount of glycogen is stored in the muscular tissue, this probably has little to do with maintaining the blood sugar level but is for the immediate use of the muscle cells. Muscular activity is associated with partial combustion of glycogen to form lactic acid. Part of the latter is completely consumed and part is reconverted into glycogen between muscular contractions. During violent overstrain lactic acid is not quickly enough disposed of; its accumulation leads to the sensation of fatigue since rest is necessary to clear the field for further action. The thyroid gland, with the best arterial circulation of any structure in the body, makes the energy of cells available for use as pointed out by Plummer. It may be said that its function is one which deals with oxidation

The arterial supply of the liver, an organ weighing between 1,700 and 1,800 grams, is comparatively small, while the venous blood from all the viscera in the abdomen is brought to it through the portal circulation carrying the products of digestion to be transformed and stored and the fluids from the colon especially its right half have to be redistilled by its functional activity. Probably the most important of these products as regards the action of the liver is glucose. Its excess of carbon is in harmony with its purpose as sugar consists of three elements: carbon, twelve parts, and the equivalent in hydrogen and oxygen of eleven molecules of water.

The exact functions of the liver have been most difficult to study and while many new facts concerning them have been recently developed there are still many of its functions awaiting elucidation. The first experimental investigations were made by ligation of its blood vessels and later by total abdominal evisceration in an effort to study as rapidly as possible while life lasted in the many types of animals used, the changes in the blood as they occur before death from the loss of function or loss of the organ. The life of such animals under the methods described for eliminating hepatic function have been very short from a few minutes to only an hour or

two at best. It is impossible to remove all of the liver without including a segment of the vena cava. However if a portion of the liver is left in the body without blood supply, the tissue is rapidly destroyed by autolysis which in turn causes a toxic condition differing very materially from the loss of liver tissue alone. This has impaired the accuracy of the results obtained by investigation in cases in which a portion of the liver is left *in situ* without blood supply. On the other hand, most of the normal liver can be removed a functioning portion with intact blood supply being left and the remaining portion will be quickly restored by hypertrophy and hyperplasia. After at least 70 per cent of a dog's liver has been thus removed without producing a noticeable effect on the animal, the approximate normal amount of liver tissue will be restored in 8 weeks. Mann developed a method of total removal of the liver in the dog which overcame the difficulties mentioned. He removed the organ in three stages. First, after a reverse Eck fistula had united the portal vein and vena cava the latter was ligated proximal to the stoma. Later, when a collateral circulation was established the portal vein was ligated. This ultimately permitted the total removal of the liver with but little impairment of return of venous blood to the heart from the lower limbs and abdominal viscera. Mann and his coworkers Magath and Bollman, found that when the liver is totally removed the blood sugar level is greatly lowered until at a definite point an animal which having shown little apparent disturbance physically from the loss of the liver, suddenly develops muscular weakness and in a short time becomes moribund. However the injection of glucose 0.25 to 0.50 grams to each kilogram of body weight of the animal restores it immediately to normal. Without this, death would have followed in a few minutes. If the blood sugar is maintained at approximately normal level by administration of glucose the animal may be sustained in a comparatively active physical condition for many hours, the longest time has been 35 hours. Death is eventually caused by other conditions than loss of sugar.

**Metabolism of bilirubin.** Bilirubin has long been regarded to a large extent as produced

in the liver, and a portion in all probability is of hepatic origin. However, it is also made outside the liver from hemoglobin in the reticulo endothelial areas of the body. The bilirubin content of arterial blood in all parts of the body is the same. Venous blood returning from the spleen or from bone marrow, areas which contain reticulo endothelial cells, shows a definite increase in its bilirubin content while the bile pigment content of venous blood returning from the kidney, muscle, or from an extremity after removal of the bones only remains the same as that of arterial blood. When the liver is totally removed from a dog the animal becomes jaundiced because of the loss of the means of excreting the bile pigment that is produced in the spleen and bone marrow.

**Metabolism of urea.** Many nitrogenous compounds are very unstable, when confined in condensed masses chemically the nitrogenous molecule becomes the explosive energy of warfare. In the body the protein matter taken as food is split in the intestines into many varieties of amino acids. The amino acids are all taken into the blood and those which cannot be employed to restore tissue are changed by the liver into glucose and urea. About 60 per cent of the energy containing carbon portion of the protein is thus saved to the body as glucose while the nitrogen which the organism does not utilize is converted into urea and eliminated by the kidneys. When the liver is totally removed urea is not formed and uric acid is not destroyed, proving that the liver is necessary for these important phases of nitrogen metabolism. The liver then not only furnishes the coal bunker but prepares the ashes of destruction in a form for removal. If the liver is removed during the hyperglycemia following extirpation of the pancreas the blood sugar becomes lowered more rapidly but the conditions otherwise are the same.

**Function of the gall bladder.** There has been for a long time, much discussion about the absence of the gall bladder in some animals. Its presence or absence does not seem to follow any definite rule and is never a familiar characteristic. With few exceptions however the leaf eaters have no gall bladders, thus

group also includes those animals that cast their horns and antlers yearly. Leaves as a food have a higher calcium and potassium content than grasses. The pocket gopher, passing his life beneath the surface of the ground has no gall bladder, while the striped gopher living beneath the soil but feeding above it has one. The rat has no gall bladder, but the liver makes bile eight times stronger than the bile of the mouse which has a gall bladder.

The liver as well as the pancreas arises from a common diverticulum of the foregut. This elongates to form the common duct together with a solid outgrowth which becoming hollow later attaches to the hepatic substance to form the gall bladder. The great mass of liver tissue checks blood pressure to a low point within it while the gall bladder with its cystic artery has the full arterial pressure. Mucus cannot be as readily absorbed as bile. The mucous membrane of the gall bladder continues to form mucus after obstruction of the common duct. At first the gall bladder contents are saturated with bile salts which later become reabsorbed and the gall bladder and all ducts remain filled with mucus or so-called white bile. The gall bladder contains approximately an ounce of bile under normal conditions. The cystic duct is one eighth of an inch in diameter being tortuous like the letter S and unites with the common duct which approximates one sixth of an inch in diameter. Sweet has described minute sacculi distributed along the hepatic duct which could possibly to some extent absorb bile fluids. The gall bladder has no suction power and can fill from the common duct only by contraction of the terminal sphincter muscle of the common duct at its opening into the duodenum which has been given the name of its discoverer the sphincter of Oddi. Meltzer worked out the law of contrary innervation as applied to the gall bladder and sphincter of the common duct. He suggested that magnesium sulphate would relax the sphincter. Lyons, employing a Rehfuss tube passed from the stomach into the duodenum which makes it possible to deliver fluids into the duodenum uncontaminated by gastric juice, made use of this suggestion of Meltzer to develop his so

called physiologic drainage of the gall bladder. Peptone is also thought to relax the sphincter. Intraduodenal lavage with such solutions is supposed to cause the sphincter of Oddi to relax. The first bile that appears is darker than the bile of the hepatic duct and lighter than the bile from the gall bladder. This is followed by the dark gall bladder bile and later by the light bile flowing from the hepatic ducts into the duodenum from which it is sucked by the Rehfuss tube. On the other hand, Sweet and Halpert contend that little or no bile which enters the gall bladder through the cystic duct leaves by that route. The pressure withstood by the sphincter of Oddi in the animals without a gall bladder is very low, being but a few millimeters of water. In such species, the bile passes into the duodenum without obstruction. In those animals which have a gall bladder the pressure is not necessarily the same in the gall bladder as it is in the common duct, and varies from 50 to 150 millimeters of water. The gall bladder in contracting during filtration closes its outlet. As a result of the association of activity of gall bladder and sphincter removal of the gall bladder is followed by relaxation of the sphincter of Oddi to the level of that in animals without a gall bladder, as a rule. At the angle at which the pancreatic duct unites with the common duct, the sphincter of Oddi usually cannot accomplish its closure without interfering with the pancreatic duct. Fortunately, the pancreas has two ducts usually connected. The pain in the back accompanying gall stone colic is probably due to pancreatic colic. In the gall bladder of man bile is ten to eleven times as concentrated as the bile in the hepatic ducts. In diseases characterized by dark bile and salts and stones it is much more concentrated than this.

Ligation of the common duct in animals with a gall bladder distends the gall bladder and probably increases its function of filtration of fluids. In dogs sufficient bile pigment appears in the blood in from 24 to 36 hours to give a positive van den Bergh test. Clinical jaundice does not appear for from 72 to 120 hours. However if the gall bladder is removed or the cystic duct ligated at the same time the common duct is ligated, bile pigment appears

in the blood in amounts sufficient to give a positive van den Bergh test in from three to six hours and jaundice in twenty four hours. For some reason then in certain types of life there is a need for concentrating bile or for bile fluids to reach the blood stream through the lymphatics without coming in contact with the alimentary canal. In some animals without a gall bladder the presence of its physiologic equivalent has been demonstrated. In the case of man this may possibly have been more important ages ago than now, although only a few cases are on record in which there is congenital absence of the gall bladder in man.

#### HEPATIC FUNCTION IN DISEASE

*Formation of gall stones.* Gall stones are of varying color and density, single cholesterol stones crystalline and amorphous are found in gall bladders with little change from the normal. Less concentrated cholesterol with varying quantities of bilirubin of calcium and bile salts form the great mass of gall stones. Among the thousands of patients operated on one practically never finds a stone in the process of formation although recent stones may be soft and others of varying degrees of hardness in the same gall bladder. A stone may increase by secretion of bile salts retained in a gall bladder compelled to filter an excess of bile fluids at a higher constant level of pressure produced by a contraction or spasm of the sphincter of Oddi. The trigger action of excess of fatty bodies in the blood and towns of infection may suddenly and as quickly start and complete the formation of a stone or the addition of another layer to a stone as a hen can cover an egg with carbonate of calcium that is in one day. The conception of disease of the gall bladder from overwork is being recognized as the basis of the development of gall stones. The excess of cholesterol in the blood is eliminated by the liver. Cholesterol forms one fourth of the blood fat and it is increased in pregnancy. Cholecystectomy is now performed unless it is contra indicated by special complicating conditions. The gall bladder is darker if the liver is diseased its edges are rounded and not sharp and rapidly spreading like the normal axe like edge. It is

mottled and the fine lobulations on its surface are readily seen. The area of lymphatic filtration around the gall bladder attachment extending for 2.5 or 5 centimeters may show in many cases extensive connective tissue giving a local cirrhotic appearance but of lighter color. The glands on the cystic common and hepatic ducts are enlarged in proportion to the hyperfunction thrown on them through excess drainage. Back of the trouble is the suggestion that stimulation of the sympathetic nervous system may account for spasm of the sphincter of Oddi which undoubtedly precedes and accompanies not only hepatic changes but diseases of the gall bladder itself and its secondary gall stones. The stimulation of the sympathetic system may be the result of changes in the hepatic function dependent in turn on injudicious eating and the strain of modern ways of living. The amount of sugar eaten by the individual has increased a pound a year for 100 years and now amounts to approximately 112 pounds.

An excess of sugar fuel above what can be immediately used or stored as glycogen is converted into fat and deposited in and over the body as such and like a blubber that insulates arctic animals is a hydrocarbon which is mostly again reconverted into sugar for burning in case of need.

We all have a most wonderful sugar machine of our own for reducing carbohydrate food to glycogen. Is it possible that we are stoking our human furnaces too heavily and burning out our boiler flues (the overworked kidneys) and that the retention of the ashes destroys our fire boxes and grates?

Nowadays we live in flats and kitchenette apartments and eat canned foods. Scientific progress permits us to enjoy preserved foods from every corner of the world but it is possible that man has physically failed to keep pace with such progress. These canned foods contain insufficient amounts of vitamins and in cold storage food the vitamin is in varying degrees of decay. It is possible that we are paying too heavy a price for our conveniences and luxuries at any rate these are points for investigation in the near future.

In 1910 Rowntree studied phenolsulphone phthalein as a test of renal function. During

his experiments he found that the chlorophthalins were eliminated by the liver and thrown into the alimentary tract with the bile. Tests of the stool gave but an approximate valuation of hepatic function. Rosenthal made this more accurate by the test of injecting dye material into the blood and determining the rapidity with which it was removed from the blood by the liver.

Graham and his coworker, Cole, found that the bromine and iodine substitution products of phenolphthalein were eliminated by the liver and when thrown into the bile entered the gall bladder in a normal manner and made its size and shape visible by fluoroscope or roentgenogram. When it was in a diseased condition or contained stones, very little or none at all of the dye entered the gall bladder. This lack of visibility of the gall bladder made diagnosis of disease of it probable. The reaction of the injection has been overcome in the clinic by giving the phenoltetrabromophthalin in a capsule by mouth containing 0.1 gram of the dye for each kilogram of body weight. It is of assistance in those cases which puzzle the diagnostician. Mann showed that the liver has an affinity for the chlorines to the degree that the injection into the blood stream of from 5 to 10 cubic centimeters of the Carrel-Dakin solution for each kilogram of body weight acts on the gall bladder and does not injure any other tissue unless a sufficient amount is used to destroy the animal. Repeated injections will seriously injure the viscus.

The bilirubin of the serum is now determined quantitatively and specifically by means of the van den Bergh test. Whereas the content of normal serum never exceeds 2 milligrams for each 100 cubic centimeters, values up to 20 or 30 milligrams for each 100 cubic centimeters may be encountered in jaundice. The nature of the reaction also indicates in many instances whether jaundice is obstructive or hæmolytic in origin.

#### RELATION TO SURGERY

*Status of the gall bladder.* Years ago cholelithic disease was mainly considered to be gall stone disease and the operation consisted of cholecystostomy, removal of the gall stones and drainage, every effort being

made to conserve the gall bladder. There was no knowledge of the formation of the gall stone or the conditions leading thereto. Later advances led to exploration in many cases in which there were symptoms of gall stones. If no stones were felt, the gall bladder was not opened, but if symptoms and more severe spells continued, within a few years a second operation would be performed and the gall bladder would not infrequently contain many stones. Cholecystitis or inflammatory disease was discussed and cholecystostomy performed on the gall bladder with adhesions, change in color, and thickened wall. Not only was the disease unaffected but in many cases adhesions arose after operation which attached the gall bladder wall to the abdominal wall leading to more trouble than before operation, and cholecystectomy entered the field of surgery for the diseased gall bladder, whether stones were present or not. At this time a sufficient interval had elapsed since the original removal of gall stones for many patients to have had recurrence of symptoms, and operation for the removal of newly developed gall stones a second or even a third time within a few years. It was concluded that the gall bladder was probably not so important a structure as it was at first believed, and like a diseased tonsil a diseased gall bladder could be removed with benefit to health.

*Operative risks.* Bile in the blood, from obstruction of the common duct, greatly delays its coagulation time. Hæmorrhage is one of the serious risks of operation during conditions of jaundice. While many have made a study of this problem in the clinic it has been carried on by Hallenbeck and Giffin and finally standardized by Walters who prepares such patients by injecting intravenously 5 cubic centimeters of a 10 per cent solution of calcium chloride once daily for 3 days preceding operation, in hundreds of cases we have had no untoward accident or local destruction of tissue from these injections such as have been described. This method brings the coagulation time which has been from 12 to 20 minutes down to from 6 to 9 minutes and greatly lowers the risk from hæmorrhage. The improvement is maintained if in the operation, the surgeon is able to provide drainage of



bile internally and externally and thus relieve the tension in the liver regardless of the cause of obstruction. Many persons chronically sick who have taken but little food for weeks have difficulty in maintaining their blood sugar level. Therefore sugars are given by mouth, and glucose by bowel if required before or after serious operations.

The most common cause of death following surgical operations is disease of the lungs, the next renal complications and the third cardiac complications, although the latter condition is most feared by those who are ill.

*Embarrassment of hepatic function.* When the liver is under continued stress from congestion and the higher pressure from spasm of the sphincter of Oddi, it continues to form bile. On account of the low blood pressure in the liver tissue the back pressure is not so serious nor so rapid in its results as chronic obstruction of the urinary bladder by a hypertrophied prostate and the sudden relief of tension caused by draining the hepatic duct in cases of jaundice with white bile is seldom associated with the same risk as attends the sudden emptying of the greatly distended urinary bladder in old men, although a sudden cessation of hepatic function sometimes follows comparable to the cessation of renal function. Greatly distended gall bladders require mechanical devices to provide for slow emptying.

In certain cases when the liver is not functioning adequately, it may be relieved or as-

sisted. Administering bile frees the gall bladder under tension during fasting. Its flow is increased by ox gall and nitrogenous food but not by calomel. Rich carbohydrate food checks it. In the chronic deficiency of the liver associated with cirrhosis and splenic enlargement, the removal of the greatly enlarged spleen reduces by 20 per cent the work of the liver and relieves and conserves the organ. In the probable deficiency consequent to chronic general disease with emaciation, the physician must think of the lack of liver glycogen to maintain blood sugar and nourish the patient accordingly. If any kind of operation is required for such patients the surgeon must be prepared to restore blood sugar by the intravenous injection of glucose and also to maintain a normal or higher temperature during and after operation. By such conservative methods the old death rate of from 10 to 15 per cent attending operations in the presence of jaundice has now been lowered to 3.5 per cent.

Ascites may not be entirely the result of hepatic deficiency, but may depend on some obscure systemic defect. Treatment by novasurol has shown more satisfactory and more permanent restoration of hepatic function than the mechanical withdrawal of the fluid. The embarrassment of the liver in cirrhosis with ascites is not to be explained entirely by the vicious circle of endogenous and exogenous pressure.

CARCINOMA OF THE MALE BREAST<sup>1</sup>By E STARR JUDD MD FACS ROCHESTER MINNESOTA  
ANDHARRY D MORSE MD ROCHESTER MINNESOTA  
Fell w in Urology The Mayo Foundation

THE etiology of carcinoma of the male breast is undoubtedly the same as of carcinoma elsewhere. Differences in function probably account for its comparative rarity in the male.

The male and female breasts are embryologically of the same origin and develop alike until puberty. At this period the female breast undergoes a marked change coincident to the development of sex characteristics. New ducts, glandular elements and so forth, are formed. Pregnancy produces another characteristic change, namely an hypertrophy and hyperplasia of the glandular structure which is followed by regressive changes at the cessation of lactation. Finally after the menopause the glandular elements atrophy. This marked difference in function with rapid proliferation and regression during pregnancy (which may be often repeated) and the regressive changes following the menopause explain to a certain extent the more frequent occurrence of carcinoma in the female breast.

Carcinoma of the male breast was first recognized and described by Thomas Bartholinus (1616-1680). Our present knowledge of this condition is based on the *Pomer Theiss* (1883) and the analysis of 100 cases by Williams in 1889 and 472 cases by Schuchardt in 1890. Williams in a series of 242 neoplasms of the breast found 397 in women and 25 in men, and of the latter only 16 were carcinoma. According to Schuchardt the percentage of occurrence in men as reported from various sources is from 1.8 to 8.4 per cent. Later Warfield in 307 cases of carcinoma of the breast found three in males. In the present series 1,751 were in females and 17 in males.

The relative occurrence in the two breasts has been variously reported. Fitzwilliams sums it up and says in 296 recorded cases of carcinoma of the male breast, 143 were on the

left side and 148 on the right, while in 5 the condition was bilateral. In our own series, the left breast was affected in 10 cases and the right in 7.

It is generally accepted that the disease occurs a few years later in males than in females, although Blodgett reported finding it in a boy aged 12 years and Bryaa observed it in one at the age of 14 years and 8 months. In Lunn's report the oldest patient was 91 years. In our cases, the oldest was 72 years and the youngest 38 years, the average age being 52.6 years. Eight of the 17 male patients were in the fifth decade.

There was a history of injury to the breast in only one case and in only 4 was there a family history of cancer.

The known duration of the tumor before operation is variously stated as from 1 to 3 years. However, a search of the literature reveals a report by Owens and Eisendrath with the history of a patient who had a tumor of the breast for 35 years while Moore records the case of one who had a tumor for only 2 weeks. One of our patients gave a history of a tumor for 18 years although increase in size had occurred for only 2 years preceding operation, the shortest history was 4 months with the average duration 31.2 months.

The pain, bloody discharge from, and retraction of the nipple, and ulceration vary with the type, situation, and extent of the carcinoma, the variations being similar to those of carcinoma found elsewhere in the body. That ulceration in the male breast is more common than among females is readily understood when one considers the normal relative difference in the distance from the overlying skin in the two sexes. Differences in the amount of retraction of the nipple are shown in Figures 1 and 2. Figure 3 shows a still more advanced type and illustrates ulcer

TABLE I—CARCINOMA OF MALE BREAST

Case	Age	Family history of carcinoma	Duration	Site of primary	Side	Gl. involved	Ext. to pectorals	Grade	Remarks
1	44		1		Left	4		4	Died 2 years after operation multiple metastatic lesions present
2	72	Mother died carcinoma of breast	1		Left	4	+	4	Died 10 months after operation malignant disease remained in axilla N
3	63		/	+	Right	+		4	Patient relocated
4	56		/		Left	+		3	Died 6 years after operation N present without evidence
5	43	Father died carcinoma of breast			Right			4	Letter 6 years after operation patient in excellent health but probably died of tuberculosis
6	69		1		Right			3	Died of cause not known
7	42		3		Right	4	+	3	Simple amputation elsewhere 8 months before death 16 months after operation healed
8	49		18		Right	+		3	Simple mastectomy elsewhere 8 months before death 18 years after operation healed with no recurrence died 6 months later
9	54				Left	4		3	Operation of cause not known
10	4		13		Left	4		3	Eleven months after operation severe general weakness multiple metastatic lesions in lungs and pelvis at death 9 months after operation
11	37	Mother died carcinoma	3		Right	+		4	If no doctor present died of pneumonia in hospital 7 months after operation
12	46				Left	4			Simple amputation performed elsewhere 3 years before death 10 months after operation healed with multiple metastatic lesions
13	48	Father died carcinoma of stomach	6		Left	4		4	Six months after operation severe general weakness multiple metastatic lesions of right pelvis bones and femur died within 7 years
14	43		1		Left	4		4	Good results 10 months after operation
15	51				Left	4			Unable to locate
16	52		3		Left				Died following spread of hyperphosphoria 6 years after operation carcinoma of breast
17	60				Right			4	Letter 3 years after operation no evidence of metastatic disease

\*Roentgenograms of the breast were negative in each case.

ation also metastatic nodules. Protrusion of the nipple is shown in Figures 4 and 5. In Figure 6 the original site of the neoplasm was probably as remote from the nipple as possible and the nipple involved by extension. Involvement of the nipple is the rule not the exception because of its inherent susceptibility to carcinoma but because of the small amount of glandular tissue underlying it.

A radical operation was performed on each of our 17 patients. One death occurred making an operative mortality of 5.8 per cent. Eleven of the 17 patients had one or more roentgenological treatments postoperatively. Eight of the 11 are dead and we were able to obtain information as to the postoperative length of life in all but 1, the average duration

being 22 months. Three patients are known to be alive: 1 for 3 years, 1 for 16 months and 1 for 6 months. Six of the patients did not receive postoperative treatment with the roentgen ray and of those 3 are dead: 1 after 4 years, 1 within a month and 1 was reported dead but the length of life not stated. One is alive 6 years after operation, and 2 have not been located.

In 14 of the 17 patients we performed the primary operation; in 3 the radical procedure was for recurrence: 15, 18 and 24 months after simple amputation done elsewhere. One of the 3 patients had no evidence of a recurrence 18 months after the secondary operation; 1 died 18 months and 1 10 months after operation. Two of the 17 patients have never



Fig 1 Small neoplasm immediately beneath and involving the nipple producing retraction of it



Fig 2 More advanced stage of retraction of nipple than in Figure 1

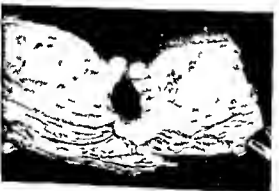


Fig 3 Still more advanced stage of retraction than shown in Figures 1 and 2 with ulceration and metastasis

been heard from. Two were reported dead but the date and cause of death were not given. One patient died after operation from erysipelas. Seven died from metastatic lesions demonstrated in necropsies performed here or reported by physicians elsewhere. The greatest postoperative duration of life



Fig 4 Small neoplasm immediately beneath and involving the nipple producing protrusion of it



Fig 5 More advanced stage of protrusion than in Figure 4



Fig 6 Involvement of the nipple by direct extension from a distant neoplasm

was 6 years and the least 7 months, the average being 19.5 months. One patient died following nephrectomy for hypernephroma 4 years after the radical amputation of the breast for carcinoma and at necropsy no evidence of metastasis from the original tumor was found. Four patients are alive and show no evidence of any recurrence 6 months 16 months 3 years and 6 years after operation.

Thirteen of the 17 patients had varying degrees of glandular involvement. Of the remaining 4, 1 has lived for 6 years and 1 for 3 years since the operation. 1 has not been traced and 1 was reported dead but no information was given as to the date or cause of death.

These cases as a group showed a very high grade of malignancy when classified according to the method of Broders. 8 were graded 4, 6 were graded 3, 2 were graded 2 and in 1 case the tissue had not been preserved. That a high grade of malignancy is the rule in cases of carcinomata of the male breast cannot be definitely asserted as our observations are based on a small group but nevertheless it would seem to explain the uniformly poor ultimate results obtained even with the most radical operative procedures.

#### CONCLUSIONS

1. It is probable that carcinoma of the male breast in most instances is a highly malignant type of neoplasm.

2. The results of radical operation for cancer of the breast are not as satisfactory in males as in females very likely because in the former the tumors are generally of a higher degree of malignancy.

3. Tumors in the male breast should receive immediate radical operative treatment.

4. Good results are obtainable only by radical operation before glandular or other metastatic lesions occur.

5. Roentgenological treatment postoperatively does not seem to have arrested the progress of the disease to any appreciable extent in this series of cases.

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TUMORS OF THE URACHUS<sup>1</sup>

WITH REPORT OF SEVEN CASES

BY FRID W. RANKIN, M.D., F.A.C.S., LEXINGTON, KENTUCKY

AND

BENNETT PARKER, M.D., ROCHESTER, MINNESOTA

F. I. W. S. S. S. M. Y. C. C.

**B**ENIGN pathological conditions in the urachus are not uncommon and a great deal has been written of them. There is much less in the literature on malignancy of this structure, probably because this condition appears less frequently than the benign and probably also because malignant growths have been frequently overlooked. It is extremely difficult in some cases to draw a fine line of distinction between tumors of the umbilicus and those of the upper portion of the urachal tube. However, it must be remembered that a large percentage of pathological conditions of the urachus occur in its lower half.

In early fetal life the urachus develops from the allantois and until about the second or third month normally remains patent. At that time it becomes obliterated and forms a cordlike structure running from the apex of the bladder to the umbilicus and serves as a median suspensory ligament of the bladder. The canal does not become obliterated simultaneously throughout its length but at irregular intervals so that small areas remain in which the lumen still persists. These may disappear later or they may persist in the form of spindle-shaped cavities which probably give rise to many of the urachal cysts which we see clinically. The lining of this urachal tube is composed of one or more layers of transitional epithelium very much like the mucous membrane of the bladder. There is a circular and a longitudinal coat of non-striped muscle about the canal which in turn is surrounded by connective tissue (Fig. 1).

It seems fairly well established that many persons go through life without symptoms with urachi which we do not consider normal. Urutz (2) examined 74 bodies for cysts of the urachus and in this number he found 24 undoubted instances. Morse (7) in 21 consecutive postmortems found 13 cases in which

either a cyst or a patent urachus existed. In none of these cases had there been any ante mortem indication of these pathological conditions. Of these 13 cases 5 were females and 8 were males. This sex relation is near that given by Cullen (1), who found that in congenitally patent urachi of 53 recorded 35 were in males and 18 in females. However, Weiser (12) found in 89 cases that the sex ratio was 3 females to 1 male. The average age in the cases examined by Morse was 43.7 years. Gibb (4) says that cysts occur more commonly in females while the patent urachus is more commonly found in males. He believes that this is true because of the greater occurrence of urethral strictures in men and also because of prostatic conditions which may cause urinary obstruction.

**Patent urachus** (Fig. 2). As we have said many persons with patent urachi go through life ignorant of the condition which is present. If by any chance there should develop some obstruction to the normal urinary outlet with sufficient back pressure a patent urachus might be brought to light for the first time. Just such an instance was recorded by Gibb (4). In a male 74 years of age for 3 years there had been a gradual decrease in the amount of urine passed through the urethra. There was then an increased flow of urine at the umbilicus and one month before treatment was instituted all the urine was draining from an umbilical sinus. It was found that he had an enlarged prostate which was causing obstruction. A suprapubic prostatectomy was done followed by bladder drainage for 12 days with complete recovery.

A patent urachus may be closed in any part of its extent. It may be open at either end or both. The openings may be large or small, usually the bladder opening is the larger and often it is so large that the sacculated lower

<sup>1</sup>The note at the bottom of this paper is from the J. of Surgery, M. Y. C. C.



Fig. 1 (1 H) Showing a urachus near the bladder attachment (X 60)

Fig. 2 Showing a patent urachus at its bladder attachment (X 30)

end of the urachus forms a receptacle as large as the bladder itself. The urinary drainage at the umbilical end of the canal may be a few drops in a day or it may be a large stream of urine especially when the patient is voiding. In Paget's (8) case reported in 1850 the patient voided urine through the umbilicus whenever he lifted a heavy object or micturated. Any act which increases the intravesical tension increases the possibility of drainage from the umbilicus when a patent urachus exists. This actually occurred in Case 1. When the patient stretched urine and a purulent material would discharge from the umbilicus.

**CASE 1.** Miss F. 9, aged 26, came complaining of kidney and bladder trouble. Every 2 to 3 days for 9 years the patient had had pain between the symphysis and the umbilicus as associated with a purulent and occasionally a bloody discharge from the umbilicus. At times there was urinary discharge with radiating pain downward into the bladder region. This pain and discharge almost invariably would follow the act of stretching. There was marked increase in frequency of micturition, burning after voiding and occasionally there was blood, pus and stringy material in the urine. The physical examination was essentially negative save for slight induration and tenderness in the midline between the symphysis and umbilicus. A 4 hour specimen of urine showed a slight amount of albumin and a few pus cells. The blood count showed a normal red cell determination, white blood cells 7400, hemoglobin 60 per cent and the Wassermann was negative. Roentgen ray plate of the kidneys, ureters and bladder were negative. Cystoscopic examination showed a real cystitis III on the basis of IV. A diagnosis was made of a patent urachus and operation advised. At operation the umbilicus and the urachus with its two obliterated hypogastric arteries were excised. The urachus

was small and cordlike in structure with no evidence of tumor formation. Grossly it was not possible to establish the presence of a lumen in the urachus. The peritoneal cavity was not opened. Pathological examination of the specimen revealed a cyst of the umbilicus approximately 1 centimeter in diameter which drained a sinus originating in a patent urachus. The lumen of the urachus was 1 to 2 millimeter in diameter throughout its entire length. The bladder was irrigated following the operation with great improvement and the patient was discharged from the hospital apparently cured.

It is difficult to say just what relation the persisting urachus could have had with the severe cystitis in this case. From the history the bladder symptoms appeared at about the same time that the umbilical discharge was first noticed. That there was a definite relation between these two conditions seems fairly certain as the bladder condition rapidly cleared up with the excision of the fistulous tract and with bladder irrigations following the operation. It is our belief that the patent urachus harbored a low grade infection and that this constituted the source of infection for the bladder and that the vesical symptoms promptly disappeared following the eradication of this focus of infection.

Large cysts infected cysts cysts with fistula or with neoplastic degeneration are the only ones which we consider surgical. Probably the largest known cyst of the urachus was Rippman's case reported by Cullen. The mass filled the abdomen and contained 52 liters of fluid. The larger cysts may be pedunculated and extend into the abdominal cavity. Means (6) reports a case of a young man 3 years of age who for 3 months had

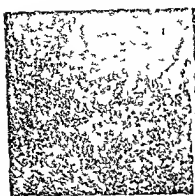


Fig 3

Fig 3 An occasional foreign body giant cell numerous plasma cells and fibers in the old chronic area and many polymorphonuclear leucocytes and some necrosis ( $\times 100$ )



Fig 4

Fig 4 Fibroma ( $\times 100$ )



Fig 5

Fig 5 Showing spaces of variable size lined with pseudostratified columnar epithelium and within the lumen exudate of serum and red blood cells. Adenoma ( $\times 120$ )

been troubled with a sensation of pressure and soreness in the lower abdomen between the symphysis and the umbilicus. The patient had felt a mass some time before which was definitely palpable at the time of his examination. At operation a large pedunculated cyst was found hanging free in the abdominal cavity and completely covered with peritoneum. The cyst was removed with the remnants of the urachus to which it was attached.

Abscess and infection of a cyst or a patent urachus may give a train of constitutional symptoms suggesting infection but the location of pain which is usually present gives the clinician an indication as to the probable cause of the trouble. The abdominal pain at times is exaggerated by deep breathing and may be more marked when the patient is walking erect. There may be chills and fever, anorexia, loss of weight and indigestion. In some the abdominal pain is the predominant complaint and is usually located in the midline between the umbilicus and symphysis. Diarrhea has been reported as a symptom although it is rare. Usually there are few or no bladder symptoms present unless the infection has spread to the perivesical structures or the infection has produced a secondary cystitis. An abscess is usually adherent to the posterior rectus fascia in front and to the peritoneum behind and if the infection is acute and extensive the omentum nearby may be adherent to the parietal peritoneum.

**CASE 2** Mrs. F. B. C. aged 55 presented herself complaining of rectal trouble, tumor in the abdomen and a discharge from the navel. This trouble began about 10 years previously when a doctor found an abdominal tumor. An operation was advised but was refused. About the same time the umbilicus began to drain pus and blood and ever since that time the navel has drained at irregular intervals. There was usually a cab at the site of the drainage and when it was removed pus and blood would escape from the navel. There had been no increase in the size of the abdominal tumor and it had never been tender although she had noticed that she would feel better when walking stooped slightly forward. Six years previously she had had a purulent and bloody discharge from the vagina for a few weeks which she said was of the same character as the drainage from the umbilicus.

The physical examination was of a fairly well developed and nourished individual. There was an abdominal tumor midway between the symphysis and the umbilicus apparently with no attachment to the uterus which seemed to be connected to the abdominal wall and the umbilicus. The tumor was more to the left side than in the midline. There was a small sinus at the navel which was discharging small amounts of purulent and necrotic material and the surrounding skin was reddened, thickened and excoriated. The urine showed some albumin and a large amount of pus. The blood count was entirely normal and the Wassermann was negative. Roentgen ray examination of the large bowel showed a spastic colon. Proctoscopic examination revealed a few small internal hemorrhoids and the mucous membrane of the anal canal was very friable and easily torn.

At operation an incision was made from the symphysis up to and encircling the umbilicus. The mass was apparently in the abdominal wall and extended more to the left side than to the right. The





Fig 6 Photograph of specimen showing urachus with mass and excised bladder wall attached. The specimen has been in preserving fluid.

peritoneum was opened and the tumor mass which was about 12 centimeters long and 10 centimeters wide was removed with a large portion of the right rectus and about two thirds of the left rectus muscle together with the peritoneal attachment. The omentum was firmly adherent to the parietal peritoneum. The omentum was resected and tied off the dome of the bladder to which the tumor was attached at its lower pole. A piece of the bladder approximately 3.5 centimeters in diameter was excised.

The pathological examination revealed an abscess of the urachus. The mass removed measured 12 by 8 by 8 centimeters with peritoneal and omental attachment on its posterior surface and the bladder attachment at its lower pole. On serial section of the mass an abscess cavity 4 by 3 centimeters was found in the central portion. The walls of the cavity were from 4 to 6 centimeters thick and on microscopic examination showed an acute infection on a dense and ancient inflammatory process without evidences of malignancy (Fig 3). The patient died from peritonitis the eighth postoperative day. No postmortem was permitted.

It is interesting to note the postural relief in this case. The patient said that she felt better if she walked stooped slightly forward. This fact has been noted in a number of instances. Arrau reported the case of a soldier who had this same postural relief. Ward (11) reported a patient who had a suppurating cyst of the urachus and who experienced relief from pain when he walked stooped forward. Davis also reports a case in which there was relief of pain when the patient was lying with the legs flexed on the abdomen. It is interesting that such a tumor of the abdominal wall could persist so long and apparently without change. The patient said that there had been no change in the size of the mass since it was first noticed. If this had been infected for this long period it must have been a very low grade type and the tissues had continued to handle this burden without difficulty. There was no doubt but that

this was an infected urachus as the location was exact and its anatomical connections distinct.

**CASE 3** While the diagnosis was not proved at operation it seemed certain. Baby R. F. female aged 20 months was apparently a normal baby at birth being the first child of healthy parents. The delivery had been normal. At 12 months of age the patient had several abscessed glands of the neck which were drained operatively and were considered by the home doctor as tuberculous. The child had been perfectly well after this until 10 days prior to admission when she awoke out of a sleep with a fever of 104 degrees vomited and appeared to be sick. She then seemed well for the following 4 days then became very restless and constipated and mineral oil and milk of magnesia were used with some improvement in the condition. On the fourth to fifth day after the onset she again had fever of 102 degrees and vomited. At that time the abdomen was distended and has remained so ever since. For 7 days there had been a temperature of from 99 to 103 degrees. The physical examination revealed a well developed and nourished baby with no apparent adenitis. The abdomen was markedly distended and there was definite spasm of the rectus muscles. Around the umbilicus and involving it was a red dened area about 3 1/4 centimeters in diameter. The urine showed a slight amount of albumin an occasional red blood cell and many pus cells. The white blood count was 18 800 and the hemoglobin was 53 per cent. On cystoscopic examination a diagnosis was made of the right renal tuberculosis and possibly of the left kidney. At the time of cystoscopy an opening into the bladder near the dome was seen and a diagnosis was made also of a patent urachus. After 4 days of hot dressings the umbilicus began to drain large amounts of foul thin pus. A probe passed into this sinus would take a downward course toward the symphysis for a distance of about 5 to 6 centimeters. This patient was in the hospital for several weeks and improved greatly. It was felt that the condition was too acute to warrant radical treatment.

This case was certainly one of an abscess of a patent urachus complicated with renal tuberculosis and unfortunately we have been unable to follow it. In view of the past history of suppurative adenitis and the clinically tuberculous condition present the possibility of a tuberculous urachus must be considered. This was not proven although it must enter into the differential diagnosis.

Powell (9) reports the case of an abscess in a patent urachus in a child 9 months old. This child was of a normal confinement. The umbilical cord separated the ninth day but the wound never completely healed. The child always cried when voiding and the urine showed blood pus and albumin. There was tenderness over the lower abdomen and a small globular mass was palpable in the mid

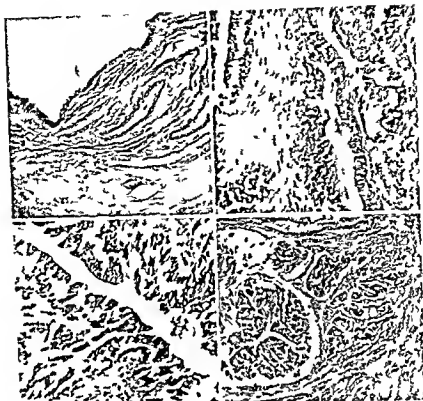


Fig 7 (above left) Showing urachus 15 centimeters above tumor mass No evidence of malignancy ( $\times 60$ )

Fig 8 (above right) Showing urachus 15 centimeters above bladder attachment with malignant degeneration of epithelium ( $\times 120$ )

Fig 9 (below left) Showing malignancy in urachus 0.5 centimeter above bladder attachment ( $\times 120$ )

Fig 10 (below right) Showing section taken at the edge of tumor mass in the bladder wall. Atypical glandular arrangement is shown with invasion into surrounding tissues ( $\times 60$ )

line just above the symphysis. Occasionally the mass enlarged and extended and at such times there was fluctuation. An abscess of the urachus was diagnosed. This was drained through the incision directly over the mass and an uneventful recovery followed.

Eastman (3) reported the case of a 19 year old woman who had pain, heat and redness about the umbilicus for 5 weeks associated with bladder tenesmus and frequency. There was a spontaneous opening at the navel and from that time on all the urine drained from this sinus. At operation a mass with the fistula was excised and microscopically was found to be tuberculous. He believes this condition was primary in the urachus.

He reports also a second case of tuberculous urachus. A woman 19 years of age had been troubled for 3 months with pain and a small swelling between the symphysis and the umbilicus. At operation, a fistula was found extending down into the space of Retzius and to the bladder. Microscopically, milium tuberculosis was found. For months there was a purulent drainage from the wound. Examination of the urine, chest, abdomen, and bladder were negative.

When abscesses of the urachus are treated surgically, preferably by drainage, a large percentage of them will be cured. If an inflammatory mass is present, excision is necessary and should be done without opening the



Fig. 11 (left) Showing stratified epithelium and fairly thick layer of corioid epithelium in outer portion ( $\times 120$ )

Fig. 12 Showing masses of undifferentiated epithelial cells arranged in glandular formation and invading the underlying tissues

peritoneum if possible. If there has been a long-standing infection the parietal peritoneum is usually adherent to the under surface of the mass and it may be impossible to remove it without opening the peritoneal cavity. Under these conditions the gravity of the operation is greatly increased because of the possibility of contamination as in Case 2. Expectant treatment, drainage and hot fomentations can be instituted and the mass extirpated when the infection has subsided.

**CASE 4.** Mrs. E. C. A. aged 45 came because of an indefinite history of abdominal bloating, gas belching and constipation. She had had a few abdominal attacks of pain which were indefinite in character. She had lost about 20 pounds of weight in 4 or 5 months. General physical examination was negative save for slight tenderness over the gall bladder region. The examination of the urine was negative. The gastric analysis showed total acids 42 and free hydrochloric acid 24. A diagnosis was made of chronic cholecystitis and appendicitis. At the time of the operation a small mass was felt in the midline below the umbilicus which seemed to be between the peritoneum and the muscles of the abdominal wall. Upon exploration the mass was found about the size of a hen's egg, adherent to the tissues below the umbilicus and apparently originating in the urachus. This mass was easily extirpated and the wound closed. Pathological examination established a diagnosis of fibroma of the urachus (Fig. 4). It was attached to the upper termination of the urachal tube which presented as a cordlike structure ending in the tissues of the umbilicus and just above the peritoneum. Fibromata and myomata of the urachus are rare and little in the literature has been written on them.

**CASE 5.** Mr. C. W. McD. aged 46 had had typhoid at 19 years of age, a Neisser infection years ago and a chancre 8 years ago. He presented himself complaining of bladder trouble. Two years previously while lifting a heavy weight he had a sharp pain in the right lumbar region. Two days later he noticed blood in the urine which has been present at irregular intervals ever since. He said he had passed gravel and pus in the urine 6 months ago. Three months ago he passed some fleshy masses in the urine and at the same time he had several colic like pains and marked frequency of urination. These pieces of tissue were taken to a doctor who after microscopic examination said they were cancer. Since the onset he has had marked frequency of urination with pain at the end of micturition when he passes blood and pus. He has had a bearing down pain in the lower abdomen and has lost 20 pounds of weight in the last 2 years. The patient was a very thin and poorly nourished man. There was a tender mass palpable just above the symphysis and with one finger in the rectum it was felt as a through and through mass just above the prostate. The rectal examination was very painful. Urinalysis showed a moderate amount of albumin, red blood cells and pus. No tubercle bacilli were found in the urine. The hemoglobin was 99 per cent. Roentgen ray plates of the kidneys, ureters and bladder were negative. Cystoscopic examination revealed a multiple diffuse papilloma covering the roof and upper wall of the bladder, multiple based resembling exaggerated granulation tissue areas as though of prevesical origin. A clinical diagnosis was made of tumor of the bladder. At operation a suprapubic exposure of the bladder was made. There was a tumor involving the lower end of the urachus and the dome of the bladder. The dome of the bladder with the urachus attached was removed. The mass measured 18 by 8 by 6 centimeters. The urachus measured 9 centimeters in length; it was 15 centi-

menters at its greatest diameter and 3 millimeters in diameter at the tip and the tumor involved its lower third. To the lower pole of the mass was attached the excised portion of the bladder. The entire mass was markedly lobulated, moderately firm and fairly well circumscribed. The gross appearance gave the impression of malignancy. Upon microscopic examination it was found to be an adenoma extending into the dome of the bladder (Fig. 5).

This case is of especial interest as it is quite similar to one of the cases reported by Schwarz (10).

Schwarz's patient was a man 57 years of age who after a fall noticed pain on urination and hæmaturia. At intervals afterward he had noticed blood in the urine and at one time had passed fleshy masses. This continued for a year before he presented himself for examination. It was impossible to palpate any abdominal mass because of marked obesity but there was an area of dullness between the symphysis and the umbilicus. Urinalysis showed many pus cells and a few epithelial cells. The cystoscopic examination revealed an area about the size of a 10 pfennig piece at the apex of the bladder with mucous membrane of unusual appearance which was described as a defect in the mucous membrane. A diagnosis was made of an extravascular tumor. The operation was performed by Prof. Ierthes. A mass the size of a goose's egg was found in the space of Retzius which crowded the bladder downward and backward. The tumor was freed easily from the anterior structures but was adherent posteriorly, had perforated the peritoneum and was intimately connected to the apex of the bladder. From the upper pole of the tumor was a cordlike structure running to the navel. The tumor was removed together with a circular portion from the dome of the bladder and the peritoneal attachment. The bladder and peritoneum were closed, the bladder drained with a retention catheter and the space of Retzius drained with a small rubber tube. The patient was dismissed from the hospital the fifteenth postoperative day in good condition. The pathological report was adenocarcinoma of the urachus with attachment to the dome of the bladder.

These two cases are similar in several respects. The symptoms occurred after some physical exertion in one, a fall and in the other the lifting of a heavy object. There was pain in both, interval hæmaturia and the passing of fragments of tissue. The cystoscopic examination in the 2 cases was similar, an unusual appearing mucous membrane in the dome of the bladder and in each instance the deduction was made that the original tumor was probably intravesical in origin. While in the case of Schwarz's patient the diagnosis

was carcinoma and in ours it was adenoma, the clinical signs were in many ways the same. The first thing that drew serious attention to the trouble was blood in the urine and this obviously must have come from some place within the urinary tract. Here then must possibly be a life saving factor, that these tumors invade the bladder or cause pressure upon it and give rise to vesical symptoms. Were this not so and in the absence of pain, the growth might go on to such an extent that operative procedure would not give a cure, as metastasis or the direct extension would have rendered the tumor inoperable. In view of the lack of physical findings the cystoscopic examination was the only means by which the diagnosis was made possible.

CASE 6. Mr. C. W. L. aged 66 presented himself complaining of kidney trouble. He denied venereal infection and the family and past histories were negative. The complaint dated back 27 years when he had a sudden and severe colic in the lower abdomen radiating around to the back associated with nausea, vomiting and with blood and clots in the urine. He had no further trouble for 12 years when he had a recurrence of the same type of attack with blood and clots in the urine. He was then free from trouble until a few weeks prior to his admission when he had the third attack, identical in nature to the other two. Since the last attack he had had blood and clots in the urine and a few mild attacks of lower abdominal pain. There had been marked frequency of urination and the patient had lost 30 pounds in weight in 5 years.

The physical examination showed an old man who had apparently lost considerable weight and had marked arteriosclerosis. The Kolmer reaction was positive. Urinalysis revealed a large amount of albumin and red blood cells and a small amount of pus. The urine was stained for spirochetes but none were found. The blood count showed hæmoglobin 58 per cent, red count 5,780,000 and white count 9,800. The phenolsulphonephthalein return was 50 per cent. Roentgen ray plates of the kidneys, ureters and bladder as well as of the chest were negative. Cystoscopic examination done March 23, 1923 showed an area on the anterior portion of the dome of the bladder of indefinite size which was irregular, necrotic and covered with blood clots. Clear urine was seen coming from both ureteral openings. A small piece of tissue was taken for examination and was reported by the pathologists as inflammatory. On April 3, another cystoscopic examination was made and at that time the mass could be determined to be about 4 by 3 by 3 centimeters in size. It was ulcerated, irregular on the surface with the edges circumscribed and bled easily. The tumor was of an unusual type and in view of the

positive Kolmer reaction it was necessary to consider the possibility of a gumma. The patient was given an intensive course of salvarsan treatment and a third cystoscopic examination was made May 2. At this time the tumor gave the appearance of a Grade III epithelioma and its position made it favorable for resection. The unusual appearance of this growth gave the impression that it was a tumor of the urachus secondarily involving the bladder.

At operation a suprapubic incision was made exposing a growth in the space of Retzius. The tumor was about 4 centimeters in diameter and apparently originated in a persisting urachus at a point near the dome of the bladder and involving it. The mass with its bladder attachment together with about 1 centimeter of normal bladder wall around the periphery of the growth and the entire urachus were removed. It was necessary to open the peritoneum because of the posterior attachment. The peritoneum was closed and the bladder reconstructed with an inner row of plain catgut and an outer row of chromic catgut. The pathological examination showed a tumor of the lower end of the urachus with the involved bladder dome attached. The mass measured 4 by 3 by 2 centimeters and the urachus was 12 centimeters long. The greatest diameter of the urachus was 1.5 centimeters at its lower end and the least diameter at its tip was 5 millimeters. Microscopic examination revealed a squamous cell epithelioma of very malignant looking cells (Figs 7, 8, 9 and 10). The patient died 7 months after the operation from recurrence. Up to the time of his death there had been no urinary symptoms but there had been 6 local recurrences to the right of the midline and just above the symphysis. These recurrences gradually enlarged each to reach the size of a man's fist. There had been marked emaciation before death occurred but the patient had not permitted further treatment for the recurrences. No postmortem examination was permitted.

This case is of especial interest in view of the long history. Yet the clinical progress in general is the same as that in the case of the adenoma of the urachus reported and similar to the case reported by Schwarz. Here we have a 27 year history of abdominal pain, interval hæmaturia, with long periods of freedom, one of these periods being 12 years. In the 27 years he had three outstanding attacks of pain and hæmaturia and in the few weeks prior to his examination the attacks were quite frequent. Clinically the positive Kolmer reaction threw some doubt upon the nature of the tumor but the subsequent operative findings and the microscopic examination established without doubt the pathological diagnosis. As in the other 2 cases which were

mentioned the cystoscopic picture of the bladder growth was unusual and the pre-operative suggestion was made that the mass might be of extravescical origin. Metastases in malignancy of the urachus occur late in the disease while the spread of it is usually by direct extension and local recurrence, as in this case.

Khaum (5) reports Hoffman's case a man 28 years of age who had had a patent urachus since he was 3 years of age.

At the age of 27 patient noticed a hardness between the symphysis and the umbilicus movable but not tender. The mass had gradually enlarged and he had dysuria, weakness, loss of weight and had become emaciated. On examination the tumor which was about 10 centimeters long was found nodular, adherent to the umbilicus and painful. The urine contained a moderate amount of pus and epithelial cells. The mass became fluctuating and ruptured discharging a large amount of purulent bloody fluid but there was no change in the size of the tumor. The discharge contained many epithelial cells with pearl formation which subsequently proved to be squamous cell epithelioma.

Cullen mentions a similar case reported by Fisher. In this instance a mass was at first thought to be an abscess and was operatively drained. Small balls of material were seen in the pus which proved to be squamous cell epithelioma. Both of the cases mentioned came to autopsy and in each instance the malignancy was found to be primary in the urachus.

Khaum says that true retention cysts of the urachus are rare because the mucous membrane of the urachus is similar to that of the bladder and has no definite secretory function. The same obscurity exists in regard to the exact origin of carcinoma. Schwarz says that he has never found glands in the urachus but he has found structures in the vortex and the trigonum leutaudi of the bladder which resembled gland formation. It occasionally happens that a carcinoma of the bladder is found which resembles the colloid carcinoma of the rectum. Rauenbusch in 10 years collected 65 cases of carcinoma of the bladder in males and of these only 1 case was a colloid type of carcinoma while in only 10 cases of carcinoma of the bladder in females he found 1 instance of colloid carcinoma. How

can we account for the origin of carcinomata, especially of the colloid type, in the bladder or urachus in which normally there are no glandular structures? If the mucous membrane of the urachus and the bladder arise from the same origin why are glands not found in each? It may be that by some process of metaplasia pseudo gland formation is built up and malignancy superimposed upon them. The bladder and urachus belong embryologically close together and develop from the embryonic rectum, the epithelial coat of which they carry with them. Therefore it is not entirely strange that occasionally gland formation may exist and give rise to a malignant process. Another factor which should be considered is the close proximity of the vitelline duct to the urachus during development. This causes us to wonder if there could be any connection between these two structures in the production of neoplastic growths.

CASE 7 Mr J G a farmer of 68 came because of stomach trouble. The family and past histories were negative. For years the patient had complained of belching gas and some constipation. Three months ago he noticed an irritation about the umbilicus which became reddened hard and at times slightly tender. There were occasional sharp pains in this region but they were never severe. Local treatment had been tried but without relief. The general physical examination was negative save for an ulcerated area about the umbilicus. Urine blood and Wassermann examinations were negative. A clinical diagnosis was made of infected umbilicus.

At operation an elliptical incision was made to include the portion of the umbilicus above the aponeurosis. The aponeurosis was then split and there was found to be a thickened mass of tissue immediately below the linea alba. This mass was about the diameter of a 25 cent piece and the tissue looked malignant. There was no evidence of metastasis or of direct extension of the growth. The pathological specimen of the umbilicus and surrounding tissues removed measured 8 by 8 by 2 centimeters. The skin was markedly thickened being 1.5 centimeters thick. It was very hard and fibrous with gross bands of connective tissue throughout the entire mass.

Sections (Figs 11 and 12) taken from the tumor showed adenocarcinoma and from the location and arrangement of the growth it appeared that it originated in the urachus and not in the umbilicus. The patient received three radium treatments over the operative site the dosage totaling 7666 milligram hours. In about 3 months there were local

recurrences. The patient refused further treatment and died September 20 1921. No postmortem examination was permitted.

Because of the location of this tumor and the fact that the tumor was definitely identified as a part of the urachus which could be easily seen it seems that this mass originated within the urachus. It did originate near the umbilicus and discharge through a sinus at the navel and this fact seems against including it as a urachal tumor.

It is more common to find the tumors of the urachus in the lower half and as Cullen says, usually in the lower third. Figure 11 shows a layer of stratified epithelial cells with a fairly thick layer of cornified epithelium in the outer portion. Figure 12 shows areas of undifferentiated epithelial cells in glandular formation invading the underlying tissues. It is impossible to say whether this was primarily a squamous cell epithelioma of the umbilicus which extended into the tissues below and by a process of metaplasia gave the picture of an adenocarcinoma or primarily an adenocarcinoma of the urachus with a change in its pathological picture as it extended to the cutaneous tissues. This typifies that group of cases in which a fine line of distinction cannot be drawn between tumors of the umbilicus and those of the upper part of the urachus.

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SECTION OF THE LEFT VAGUS FOR RELIEF OF ASTHMA<sup>1</sup>

By RICHARD A. KERN, M.D., PHILADELPHIA

From the Medical Division of the Hospital for the City and County of Philadelphia

**V**AGUS section in bronchial asthma is a new and little tried procedure. It is desirable therefore, to put on record all instances in which this operation is performed in order that a true valuation of the procedure may be reached. For this reason a case is reported in which vagus section was followed by only slight improvement.

The patient who is the subject of this report is a man 63 years old. His past medical history is negative for any other manifestation of hypersensitive ness but a niece is asthmatic. He had been perfectly well until March 1923 when in the course of an attack of acute bronchitis he suddenly developed a wheezing dyspnea that persisted and after several months forced him to give up his work and go to bed. At first the dyspnea was fairly constant but in September 1923 6 months after the onset it began to be worse in paroxysms. These attacks came several times a day with no obvious relation to any special cause and could be relieved by injections of adrenalin. At this time he was admitted to a hospital where he remained for 7 months. Various examinations were made and the usual measures for relief attempted but without helping the patient whose condition grew gradually worse. On April 19 1924 he was transferred to the Medical Division of the Hospital of the University of Pennsylvania.

Examination showed a rather emaciated cyanotic bed ridden individual with labored wheezing respiration and frequent but unproductive cough. The nose and throat were congested and several decayed stumps of teeth were present in the lower jaw. The chest was markedly emphysematous. The heart was large and the sounds feeble. The blood pressure was 116 systolic and 72 diastolic. There was a moderate secondary anemia with 10 per cent of hemoglobin and the leukocyte count varied from ten to sixteen thousand with eosinophiles ranging from none to 6 per cent. The blood Wassermann was negative. The urine contained traces of albumin and varying numbers of hyaline casts but the specific gravity had a normal range and tests for renal function gave normal results.

The usual skin tests for hypersensitiveness were performed using the inhaled substances—leathers animal hair pollens orris root and house dust—and also the foods included in his diet. All reacted negatively some of them on two occasions.

Röntgen ray examination showed a clouding of the ethmoid sinuses on both sides and some abscessed teeth. Attention was therefore first directed to these foci of infection. Thorough operative drain-

age of the ethmoid region was promptly followed by complete relief from paroxysms for 3 days. When these returned they were believed to be due to blocked drainage. A reopening of the sinuses was again followed by 2 days freedom from asthma. A third examination showed no local explanation for the recurrence of trouble but the cocaineization of the nose at this time again relieved the patient for a day or so. Later this measure also failed. Vaccines prepared from the sinus pus and from the sputum were used but gave no relief nor could positive skin reactions to bacterial proteins be obtained. The latter was attempted by the intracutaneous injection of heavy suspensions in salt solution of killed bacteria the strains recovered from the sputum (a hemolytic streptococcus a non hemolytic streptococcus and micrococcus catarrhalis) being used separately.

The attacks of dyspnea in the course of the next 2 months became gradually more frequent adrenalin alone gave less and less relief and had to be supplemented by pituitrin and frequently by morphine. At this juncture sodium iodide was given intravenously using 10 cubic centimeters of 1 per cent solution and for a few days it helped considerably. The attacks were less frequent and yielded more readily to adrenalin.

But again the relief was only transitory so that early in July 1924 he was requiring adrenalin injections at intervals of 1 hour or less. It was at this time that in desperation we considered the possibility of surgical relief.

The operative treatment of bronchial asthma has received considerable attention in Europe in the past 2 years. Section of the cervical sympathetic was the first operative procedure proposed. In July 1923 Kuemmel (9) reported his results from unilateral cervical sympathectomy in four asthmatics ranging in age from 3 to 65 years. One case was a failure but 3 patients were said to be completely relieved. Kaess (6) in 1924 reported 5 cases so treated that they were all still relieved after periods of from 3 weeks to 4 months. Flourken (2) performed this same operation on 4 patients 3 of whom at the time of reporting were still relieved after periods of 3 weeks to 5 months while the fourth had temporary relief and then a recurrence of trouble. Von Genssich (10) did a left cervical sympathectomy in a man 64 years old in whom all other

<sup>1</sup>Read before the American Association of Thoracic Surgeons and Society for Study of Asthma, Allied Conditions, Washington, May 15, 1925.

forms of treatment had failed. For 2 weeks the patient was without asthma, then the attacks recurred with great severity and at the request of the patient the right side was also operated upon. The attacks were now reduced in frequency to one daily. Two months later the costal cartilages on the right side from the second to the fifth inclusive were resected with subsequent relief from asthma.

On the other hand, Jungmann and Bruening (5) reported 3 cases of unilateral cervical sympathectomy with no relief in 1 instance and relief for only a few days in the other 2.

Just why sympathectomy should relieve bronchial asthma has been the subject of much discussion. Kuemmel (9) believes that there is such an interweaving of vagus and sympathetic fibers and consequently of vagal and sympathetic function that vagus and sympathetic should not be considered as clearly separated in an anatomical or physiological sense. Cutting the vagus he considers dangerous but in cutting the sympathetic he believes that he divides enough vagus fibers to be of benefit. Glaser (4) on the other hand believes that sympathectomy divides the centripetal fibers of a reflex arc. This opinion is shared by Kaess (6) and Moravitz (cited by Glaser). It has also been suggested that there is a lack of equilibrium between vagus and sympathetic in asthmatics and to this cause Claude (1) attributes the contradictory results obtained when the tests of Eppinger and Hess for vagotonia and sympathicotonia are applied to asthmatics.

But sympathectomy is a rather difficult procedure and needs to be done under general anesthesia for which we deemed our patient unsuitable. This together with the uncertainty as to underlying principles and results of sympathectomy led us to consider vagus section. If bronchospasm is a factor in the mechanism of asthma then division of the motor nerve supply of the bronchial musculature would have a logical basis. Kappis (7) in December 1923 reported both unilateral and bilateral section of the cervical cardiac branches of the vagus for the relief of angina pectoris. In May 1924 Frey (3) in an article calling attention to the possible dangers of section of the nerves innervating the heart,

mentioned the fact that vagal section has been performed by Kappis, and had apparently been mentioned by Kappis at some medical meeting shortly before. We have however, been unable to find a reference to the early work of Kappis, and he gives no journal reference of it in his later paper. However, we did know that the operation had been successfully performed. Our next concern was as to which vagus to cut. Section of the left vagus would involve recurrent laryngeal paralysis. On the other hand the cardiologist told us that section of the right vagus, because of its greater part in the innervation of the heart might cause trouble from the standpoint of that organ particularly so in our patient who undoubtedly had myocardial weakness and a tachycardia ranging between 96 and 120.

We chose therefore left vagus section with its vocal cord paralysis in preference to a possible fatality from right vagus section. The nature of the operation and its possible consequences were explained to the patient and he gladly consented to try anything that might possibly give relief.

Accordingly on July 19, 1924 the left vagus was cut under local anesthesia by Dr. I. S. Ravidin of the Surgical Division of the University Hospital. There was no striking immediate effect. In the 2 weeks that followed, however the asthmatic paroxysms became somewhat less severe and also less frequent so that the patient required adrenalin injections at intervals of from 6 to 18 hours only. The pulse rate to our surprise was not at all affected at the time of operation and thereafter gradually fell in the course of 2 weeks to a range between 76 and 100. Figure 1 gives an abbreviated record of pulse and respiration rate during the week before and 2 weeks after the operation.

The blood pressure likewise showed no change but continued undisturbed around 120 systolic and 70 diastolic. An electrocardiographic tracing made some weeks after operation showed simple tachycardia and a P-R interval of 0.14 to 0.15 seconds. The QRS complexes were of low voltage indicating a poor functional state of ventricular muscle.

There was no further improvement in the patient's condition. While he was no longer



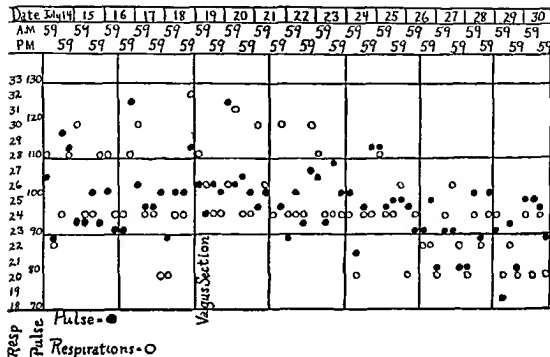


Fig. 1. Chart showing abbreviated record of pulse and respiration rate during the week before and 2 weeks after operation.

bed fast and gained 5 pounds in weight he continued to have dyspnea on slight exertion and from one to three paroxysms of asthma daily. Vaccines intravenous sodium iodide local applications through the bronchoscope failed as before to give relief. A week's stay in a room supplied with dust free washed air seemed at first to lessen the severity of the attacks but not permanently. The vocal cord paralysis interfered with coughing to some extent and the patient's voice was little more than a hoarse whisper. On January 8, 1925, he was discharged to his home but 2 months later he was readmitted to another hospital because of difficulty with adrenalin hypodermics. His present condition is practically the same as when he left our wards.

Bronchoscopic findings after the vagus section as described by Dr. Gabriel Tucker of the Bronchoscopic Clinic of the University Hospital are of interest. The tracheobronchial movements on the right side were normal; on the left there was more limited opening and

closing of the bronchus. The left bronchus did not collapse on efforts of coughing as was the case on the right side. The secretion in both main bronchi seemed about the same in amount and character. There was apparently no difference on the two sides in response to stimuli as manifested by production of cough. Five months after the operation the bronchi on the right side seemed to open more widely on inspiration and to show greater excursion in closing on expiration and on cough than did those on the left, although motion was very good on the left side. Left vagus section had apparently not materially reduced the motor nerve supply of the left bronchial tree.

In September, 1924, 2 months after our patient had been operated on, there appeared an article by Kappis (7) in which he described some of his experiences with vagus section. He first performed the operation in January, 1925, cutting the right vagus below the level at which the recurrent laryngeal branch is given off. The results were variable.

some good and some bad. No harmful effects on the heart were noted. One patient died as a result of injury to the subclavian artery at operation. In one patient a man 64 years old section of the right vagus gave some relief from asthma but there was considerable unilateral sweating. Kappis then did a sympathectomy on the same side; this was followed by a return of asthma as severe as it had ever been.

In his discussion of the indications for operation Kappis emphasizes the fact that nerve section in asthma must be looked on as a last resort and with this we heartily agree. As to whether vagus or sympathetic is to be cut, he finds it difficult to say which will help. In an attempt to answer this question he injects either the right vagus or the left sympathetic with novocain and later operates according to the results obtained. He advises against cutting both nerves on the same side and of course against cutting both vagi or both sympathetics. He has noticed some increase of bronchial secretion after vagus section. This was not the case in our patient.

#### SUMMARY

The history of a patient is reported in whom as a last resort the left vagus was cut for the relief of asthma. The operation was followed by only slight improvement. No harmful effects on heart action were observed. Bron-

choscopic examination showed diminished but not lost bronchial motility on the affected side. The subject of the operative treatment of asthma is briefly reviewed. No conclusions are drawn as to the value of vagus section in asthma on the basis of this one case. In view of the experience of Kappis, however, it would seem that right vagus section below the level of origin of the recurrent laryngeal nerve may be safely performed and is, therefore, preferable to cutting the left vagus.

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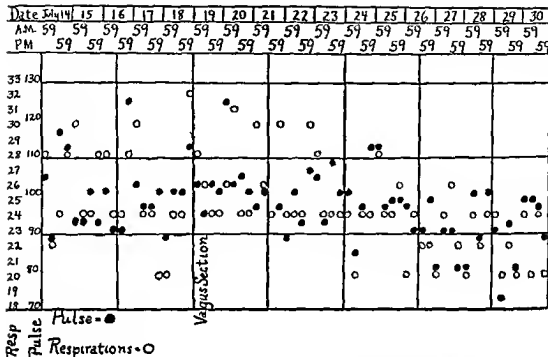


Fig 1 Chart showing abbreviated record of pulse and respiration rate during the week before and 2 weeks after operation

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tion of the ureteral anlagen dates back to the third or fourth week of embryonal life before the lower portion of the duct becomes widened and drawn into the urogenital sinus.

Of the several theories that have been advanced to explain the formation of double ureters, one of the most acceptable is that, instead of a single evagination from the wolffian duct there are two or more anlagen and each of these develops into a separate ureter with a separate implantation into the developing kidney blastema. This theory would explain the formation of a complete ureteral duplication but not of an incomplete one. The development of the latter type of anomaly may be explained by considering a precocious branching of the original evagination before the distal ends became embedded in the nephrogenic tissue the point of juncture of the two ureters depending upon the period of embryonic development at which the division of the ureteral anlage occurred.

Through expansion of the lateral portion of the allantois the lower end of the wolffian duct becomes dilated and the lower ureter is the first to reach the allantois thus determining the site of entrance to the bladder which usually is at the normal insertion of a single ureter. The wolffian duct carrying the upper ureter with it, shifts with the urogenital sinus in a downward direction between the allantois and the rectum, until the second ureter also becomes implanted in the bladder. Thus the ureter from the upper portion of the kidney is always inserted at a point lower than the insertion of the ureter from the lower renal pelvis. If the two ureters are liberated in close succession they will be found close together in the bladder if a longer interval prevails they will be further apart even to the extent of the upper ureter opening below the bladder. Meanwhile the kidney ascends from the pelvis into the lumbar region—the ureteral tube lengthening as the kidney ascends.

*Variations in position of the lower end of the ureter.* At first the ureter opens into the lower end of the wolffian duct but later becomes detached from the duct and attached to the allantois and thus to the future bladder. But if the ureter does not separate from the wolffian duct but accompanies that canal in

its downward course, there may result an abnormal opening of the ureter into the vas deferens seminal vesicle or ejaculatory duct in the male or into the rudimentary Gartner's duct in the female—these organs being derived from the wolffian duct. If the ureter after the sixth week of embryonic life still remains attached to the duct, the ureteral openings may be found in the sinus urogenitalis and the organs developing out of this namely in the upper portion of the urethra or the prostate in the male in the urethra or the vestibule of the vagina in the female. If the ureter does not remain isolated from the Muellerian tube in the female the opening may be in the uterus or in the vagina.

Thus an otherwise normal ureter may have an ectopic opening a supernumerary ureter may empty into the bladder beneath the normal ureteral opening, a supernumerary ureter may have an ectopic opening while the normal ureter ends in the bladder both normal and supernumerary ureters may have ectopic openings or ureters separate at the kidney may join to form a single tube before reaching the bladder and any combination of these abnormalities may co exist when there is bilateral involvement.

#### SYMPTOMS

In the female the type of symptoms is governed to a large extent by the site of the ectopic opening. When the opening is on the vulva or about the external meatus or in the vagina the symptomatology is definite and characteristic. From birth there is constant dribbling of urine beyond control and without sensation in addition to which urine is voided at normal intervals, in normal amounts and in response to the normal impulse of a filled bladder with complete relief on completion of the act.

The history alone should lead to a ready diagnosis but apparently the condition goes unrecognized for years in most instances the patient suffering keenly from the humiliating deformity and subjected to very definite social and economic handicaps. Being congenital the conditions naturally are present from birth, but appreciation of the presence of an abnormal condition occurs when wetting continues

## ECTOPIC URETERAL OPENINGS

## SURGICAL SIGNIFICANCE AND TREATMENT

By EDWARD F. KILBANE, M.D., NEW YORK CITY

From the Gynecology Service, Mount Sinai Hospital

**C**ONGENITAL malformations of the uropoietic system are of interest both to the student of embryology and to the clinician to the latter particularly because of the very confusing symptomatology that may be presented for diagnosis and the difficulties that may present themselves in determining the proper procedure for correction of the deformity. Practically all such cases require surgical intervention for relief if symptoms are present that cause distress or discomfort. Present day methods of urological diagnosis permit such accurate and detailed determination of the conditions present that many of the details of an anatomical anomaly of the kidneys or ureters can be demonstrated in the living while formerly such details were available only at autopsy. With such detailed information available the decision as to the surgical procedure applicable in any given case is greatly facilitated.

Kelly and Burnam classify anomalous ureteral terminations as follows:

1. In the male genito urinary apparatus (1) in the bladder (2) in the urethra (3) in the seminal vesicle (4) as deferens ejaculatory duct or prostate.

2. In the female genito urinary apparatus (1) in the urethra (2) in the vagina (3) in the vestibule of the vagina (4) in Gaertner's canal (5) in the uterus or tubes.

3. In the bowel (1) in the rectum and cloaca (2) in the intestines (3) in the urachus and amniotic cavity.

4. In cases of congenital absence of the bladder (1) in the urethra (2) in the vestibule of the vagina.

5. Blind endings.

This paper comprises a study of two patients under the author's observation each with an ectopic opening of a supernumerary ureter and a consideration of cases of single and supernumerary ureters with ectopic openings reported in literature but including only (1) in

the male ectopic openings directly into the urethra or indirectly into the urethra through the seminal vesicle vas deferens ejaculatory duct or prostate, and (2) in the female, ectopic openings into the urethra or vagina, or on the external genitals. The anomalies included in this grouping comprise a definite clinical entity and while the symptoms differ to some extent in the male and female the surgical considerations are practically the same.

The maldevelopments of the uropoietic system exemplified by supernumerary ureters and ectopic openings may be better understood through a brief study of the embryonal development of these structures. Variations in the number of ureters arise through maldevelopment of the ureteral Anlagen before the ascent of the kidney out of the pelvis. Early in the life of the embryo the cloaca represents both the future rectum and the future bladder. It gradually becomes divided by a vertical fold into two compartments with the anterior of these the allantois and the primitive excretory ducts are connected while the posterior develops into the rectum.

Entering the cloaca from the dorsal aspect are the two Wolffian ducts which furnish the parent structures of the renal pelvis and the ureters. The Wolffian duct originally developed from the pronephros is throughout the greater part of its existence the excretory duct of the Wolffian body or mesonephros. From these two primitive structures are developed most of the genito urinary system.

The ureter arises as a process or evagination from the hind wall of the lower end of the Wolffian duct. The distal portion of this Anlage divides into two branches (representing the primary division of the pelvis into two major calyces) which grow into the developing kidney blastema. Each branch divides again dichotomously and this process of branching is repeated until the calyces and straight numerous tubules are produced. The evagina

Judd reports a woman 21 years old with diurnal enuresis all her life and nocturnal enuresis when younger but not during her recent years. The dribbling in this instance was not constant but occurred only when she stood or became excited. Three attacks of sharp colic like pain in the right side of the abdomen, each attack lasting 2 or 3 days had been diagnosed as appendicitis.

Kelly and Burnam report one case in which the supernumerary ureter was almost functionless the discharge occurring only at intervals but the patient suffered much pain at the neck of the bladder.

Juvara reports a woman entirely cured after operation who for years had a small ulcer on the right side of the meatus from which clear fluid escaped. There was also tumefaction of the entire vulva and the condition had been considered a chronic tuberculous lesion because of a tuberculous trait in the family.

Kakuschkin's patient, a woman of 31 had suffered all her life from a typical incontinence. One year after a confinement fever occurred suddenly with the formation of a tumor in the right side of the abdomen and retention of urine. The fever subsided and the incontinence was replaced by a purulent leucorrhœa the pus escaping from the ectopic ureteral opening on the anterior vaginal wall. The change in the character of the secretion from the ectopic opening was evidently due to the occurrence of the pyelonephritis.

Kallmann's patient had been incontinent from infancy but continent for some time preceding operation. The supernumerary ureter ended in a blind sac behind the bladder wall. An ectopic opening was not found. Kallman concluding that in the absence of secretion the minute orifice would escape even a very detailed and careful examination. This is the only instance found in which the incontinence ceased spontaneously and it is interesting to note that a pyonephrosis followed the spontaneous closing of the ectopic opening.

Knoepfelmacher reports an autopsy on a child of 4 who died from a condition diagnosed as an extraparietal abscess. The upper greatly dilated portion of the ureter was filled with pus, while the lower segment of the ureter was contracted.

Kolsko reports an autopsy on a woman 21 years old who died from causes not in any way connected with the malformation. No symptoms referable to the kidney condition had been noted in her life. The right supernumerary ureter entered the bladder wall with the normal ureter but instead of opening into the bladder cavity passed down in the vesicle wall as a thin walled sac to open into the urethra almost at the external meatus. The escape of urine from the ectopic opening was controlled by the sphincteric action of the bladder outlet.

Lauck reports a discharge of pus from the vagina with later pus from the rectum evidently the result of an inflammatory perforation.

Mueller, quoting Stolz, reports a girl of 8 who subsequent to a fall developed a tumor of the left renal region pressure on which caused pus to flow from the urethra.

The patient of Samuels, Kearns and Sachs a woman of 29 years, had spasm and rigidity of the entire right rectus and tenderness in the right flank and right lower abdomen but no tenderness in the costovertebral angle.

Pregnancy seems to have exerted some influence in the symptomatology of some patients. Fromme reports the case of a woman of 25 well until 1 year previously when the discharge of purulent urine in the vagina began after a normal delivery. Urination was otherwise normal. J. P. Hartmann reports a woman of 49 incontinent for 24 years since her third normal labor. Previous to that, she had been incontinent only when running or on other exertion. Hayward's case was incontinent from infancy but the symptoms became much worse after the birth of a child and were always aggravated by coughing or other exertion. Jaffe reports a woman of 22 with typical incontinence for 8 months following her last confinement pain in the left lower abdomen and tenderness in the left adnexa. Judd reports a patient 48 years old with characteristic incontinence until at the age of 18 the ectopic ureter was implanted into the bladder with complete relief (reported by Maxson). Patient remained well after this for several years until about the middle of her first gestation when the incontinence recurred and

and persists beyond the age when the normal child has learned to control the bladder functions

If the ectopic opening is in the vagina or about the external meatus it can usually be identified, if searched for carefully, and a small ureteral catheter introduced. When this is possible the elicitation of the further details entails no great technical difficulties. A word of caution is here necessary. If in the course of an examination, the bladder is catheterized or a speculum is introduced into the vagina the leakage from the ectopic opening may cease entirely as the pressure of the catheter in the urethra or the speculum in the vagina may be sufficient to completely block off the flow of urine from the supernumerary ureter.

If the vagina is tamponed with pledgets of cotton and methylene blue is given by mouth or indigo carmine injected subcutaneously or intravenously the dye may be eliminated in the urine from the anomalous kidney and the stain on the cotton may be a very considerable aid in localizing the ectopic opening.

If the ectopic opening is in the urethra the symptoms are dependent upon the course of the ureter. If the latter enters the bladder wall and passes downward beneath the vesical and urethral mucosa the constriction of the musculature at the bladder outlet may exert sufficient pressure to prevent the escape of urine from the ureter except during the act of micturition under which conditions no symptoms would be noticed by the patient and the anomaly would remain unnoticed.

However, when the course of the ureter is such that it escapes the constricting influence of the vesical outlet, constant leakage occurs exactly the same as when the opening is in the vagina or near the external meatus.

Furness reports one case in which the opening was not identified either before or after operation although the diagnosis was definitely established at the operation and the incontinence cured.

When this difficulty of identification and localization of the opening obtains suggestive data may be obtained by careful cystoscopic and pyelographic examination since the pelvis and ureter communicating with the bladder on the side of the supernumerary ureter may be

found to differ in size shape and position from the pelvis of the opposite side and thus warrant surgical exploration for more detailed examination.

In the male the condition usually exists unrecognized unless the existing hydronephrosis is complicated by infection when increased temperature pain swelling etc. will be noted.

In the male but two cases have been diagnosed during life. Chute recognizing one case during an operation and Day making a complete pre-operative diagnosis. Erlach Handl Mesley and Veau Obici and Rech each report autopsy findings in male subjects in whom no symptoms referable to a urinary anomaly had been noted during life.

Peacock reports an autopsy on a male child who had been well until he was 6 months old except that he never urinated freely. From then until his death at 9 months he lost in weight from 24 to 12 pounds. During this period the abdomen showed increasing distention and was hard and tender. The urine looked like milk and had an offensive odor. Convulsions occurred a few hours before death.

Day reports a young man free from symptoms until several hours after wrenching his back in a fall when a sudden sharp pain was noticed in the left lumbar region. The urine became blood tinged and later was loaded with pus. Fever was present for a few days and during the ensuing month he lost 15 pounds in weight. On admission to the hospital he complained of malaise inability to work dull pain in the left upper abdomen and discomfort in the back.

Chute's patient had no sign of prostatic or penurethral infection but could squirt out several drops of pus from the urethra by straining after the bladder had been emptied. Pain occurred in the left side when a retention catheter was placed in the bladder the pressure of the catheter apparently preventing the escape of pus through the ectopic ureter.

Some variations from the characteristic symptoms have been noted in the female.

Hunner's patient suffered for 7 weeks from symptoms simulating stone in the right ureter but had never noticed any incontinence. The kidney was found to be replaced by a pyonephrotic sac.

for the reason that large blood vessels leading to the lower segment had been divided before the condition was fully recognized and the nephrectomy had to be completed.

*Ligation of ureter* Six ligations are reported. In four the ureter was exposed through an abdominal extraperitoneal approach and in the other two cases through the vagina.

Nove Josserand reports a case in which a urinary leakage occurred 5 days after a vaginal dissection and ligation of the ectopic ureter necessitating a secondary nephrectomy. The remaining five cases are reported as successful. Despite these favorable reports, the writer questions the advisability of ligation in any case and is inclined to condemn it in the presence of infection in either the supernumerary or normal section of the kidney.

*Anastomosis of pelvis* Stammier and Kummel and Graff report similar cases in which following ligation and resection of the right supernumerary ureter a connection was successfully established between the two pelvis after the manner of an entero anastomosis. In each instance the left supernumerary ureter was ligated and resected, the ureters and pelvis being found too small to permit a plastic joining.

*Ureteral anastomosis* Several instances are noted in which consideration was given to the possibility of joining the supernumerary and normal ureters but no report of such an operation has been discovered. When such an operation has been considered the large size of the supernumerary as compared with the normal ureter has apparently caused the operator to decide against attempting an anastomosis. In the author's two cases the disproportionately large supernumerary ureters also seemed to render such a procedure unjustifiable were the other conditions favorable.

If a case presents a large normal and a small supernumerary ureter an anastomosis of the two ureters might be feasible but again the presence of infection in the cephalic segment with the possibility of an ensuing cystitis from the infected urine should cause a grave doubt as to the advisability of this operation.

*Transurethral operations* Three cases in which operative procedure through the ure-

thra resulted in cures have been reported. Bois introduced a tenatome into the ectopic ureter and guided by a grooved catheter introduced through the urethra cut through into the bladder. The fistula thus established was kept open by passing a sound through it at intervals. At the time of reporting this case it was planned to close the ectopic opening by freshening and suturing the edges.

Hunner fastened a rubber glove finger on a ureteral catheter and then introduced this into the right ectopic ureter. The glove finger was distended with air pumped through the catheter, the distention causing a marked prominence in the vagina but not in the bladder (viewed through an endoscope) until by finger pressure in the vagina the bladder prominence was brought out. A cautery blade introduced through the endoscope was used to establish a vesico ureteral opening. This opening was probed from time to time to maintain a permanent fistula. Eighteen months later the patient is reported free of symptoms.

Wollfler (reported by Schwarz) in a girl of 12, by means of an instrument resembling Dupuytren's intestinal clamps, aimed to cause a necrosis of the wall of the bladder and the aberrant ureter. After a careful preliminary dilatation of the urethra, one blade of the instrument was introduced into the bladder, the other blade introduced into the ectopic ureter and the blades locked. On removal 6 days later a thin, necrotic membrane was found between its blades. On digital examination 6 weeks later a communicating orifice 1.5 centimeters long joined the two cavities. Eighteen months later the vesical sphincter was found to be abnormally relaxed and a twisting of the urethra according to the method of Gersuny was performed. After this the patient was able to retain urine up to 6 hours.

*Transvesical suprapubic anastomosis* Tauffer through a transvesical suprapubic approach opened the bladder and cut down on a buttoned sound introduced into the aberrant ureter, establishing a connection between the bladder and the supernumerary ureter. No suturing was necessary, so well fixed was the ureter to the bladder wall. This patient made an uncomplicated recovery to cure.



was especially noticeable when she was in the upright position. During the second pregnancy 3 years later there was a greater degree of incontinence.

In these cases in which the incontinence first appeared after childbirth it is apparent that a supernumerary ureter with a blind ending had existed and some trauma incident to the confinement had resulted in rupture of the ureterovaginal septum and the establishment of a permanent fistula.

#### TREATMENT

The choice of operation necessitates a study of all the factors that may be present in each individual case. The object of surgical intervention is the relief of the patient's symptoms with the minimum interference with kidney function. With a single ureter from the involved kidney the choice rests between a nephrectomy and the diversion of the urine from the involved kidney into the bladder through an implantation into that organ of the ectopic ureter. Here the choice will depend upon the functional activity of the kidney, the amount of infection present, and the presence or absence of sacculations and dilatation in the course of the ureter.

It does not seem that the surgeon would be justified in ligating a single ectopic ureter except under most unusual circumstances. If considerable infection is present or a kidney shows poor functional ability or the ureter is sacculated, dilated or tortuous a nephrectomy would be indicated, provided an examination of the other kidney revealed no contra-indications.

If the involved kidney shows little or no infection and is capable of good function and the ureter is fairly uniform in caliber the implantation of the ureter into the bladder may be attempted. However it is well to remember that the continuous discharge of even a mildly infected urine into the bladder may cause a cystitis intractable to treatment and with symptoms making the patient's condition worse than before relief was attempted.

With a supernumerary ectopic ureter a wider choice is available. Implantation of the supernumerary ureter involves the same consideration of infection function of the

supernumerary portion of the kidney and the condition of the supernumerary ureter. If the supernumerary kidney is a separate organ a true third kidney removal is clearly indicated with either a total or partial resection of the anomalous ureter. Two such cases are reported—one by Israel and the other by Samuels, Kearns and Sachs.

When both ureters drain a common pelvis ligation or ligation and resection of the ectopic duct provides a comparatively easy solution. However no report of such a case has been found. The closest approach is reported by Juvara who found that the supernumerary ectopic ureter arose from the normal ureter just below the right pelvis. Ligation and resection of the ectopic duct was easily accomplished and resulted in a complete cure.

Resections of the supernumerary portion of the kidney are reported by Furniss, Kakuschkin and Josephson, the latter presenting a true heminephrectomy in which a resection was made through kidney parenchyma. The feasibility of a heminephrectomy depends to a very considerable extent upon the arrangement of the blood supply to the kidney.

In the author's first case a single vascular pedicle was found to enter the supernumerary portion of the kidney. When this condition exists resection of the upper portion of the kidney involving as it does the removal of the entire blood supply is absolutely not feasible. Successful resection of a portion of the kidney is absolutely dependent on an adequate blood supply to the remaining portion and when doubt exists as to its adequacy a complete nephrectomy is safer.

Much information as to the size, shape and position of the normal and supernumerary ureters and pelves and the condition of the respective portions of the kidney can be obtained before operation by cystoscopy and pyelography. No idea of the vascular supply and formation however is available until the kidney has been exposed at which time the decision as to which operation is indicated, partial or total nephrectomy, will have to be made.

Kallmann in reporting his cases states that resection of the upper supernumerary section of the kidney could have been performed but

Pieri reports the implantation of a right ectopic ureter followed by fever and pain along the course of the ureter. A vaginal incision was made and a large amount of purulent urine released. The ureter was again implanted into the bladder but a month later a nephrectomy was necessary.

**Suprapubic implantations.** Reports of 8 cases so treated were found. Albarran through a transverse hypogastric incision exposed the supernumerary ureter and sutured the vesical and ureteral edges. His case was unsuccessful the incontinence recurring 1 week later.

Christofaletti divided the ureter and ligated the distal end. The proximal end was then implanted into the vertex of the bladder. The patient was cured.

Desnos successfully implanted the proximal end of the divided ureter into the bladder.

Hayward made a suprapubic retroperitoneal exposure and implanted the right supernumerary ureter into the bladder, with a successful result.

Judd through a right rectus incision and an extraperitoneal approach found a greatly thickened and dilated ureter and implanted the proximal end into the bladder with the decision to do a nephrectomy later if necessary. Two days later there was considerable pain in the region of the right kidney and pus was found in the urine. Two ureteral catheters were passed to the right pelvis and continuous pelvic lavage instituted. This patient is reported free from symptoms 18 months after operation.

Kuettner implanted the ureter into the bladder in an oblique direction and reports the case cured.

Schaefer successfully implanted a supernumerary ureter into the bladder through a suprapubic extraperitoneal approach.

Westhoff in a girl of 7 considering the parts too small to permit a successful vaginal approach, used a suprapubic extraperitoneal approach. An ectopic not supernumerary, ureter (left) was implanted into the bladder and the patient was reported cured 1 year after operation.

Nephrectomy while the safest and simplest operation from the standpoint of its immediate effect upon the recovery of the patient, neces-

sarily entails a consideration of all the existing factors before its choice as the operation of election. Nevertheless its performance should cause no hesitation if the general condition of the patient including the demonstration of a normally functioning opposite kidney warrants it and anatomical and pathological conditions present seem to preclude the success of more conservative measures.

Chute removed an entirely destroyed left kidney. There was complete duplication of the pelvis and ureters and separate arterial supply to each portion of the kidney. Some years later a cystogram showed the remains or stump of the dilated ureter appearing as a diverticulum the size of a small sausage and evidently the source of very foul urine. With the exception of Day's case this is the only report of an operation on a male patient.

Day removed the left kidney which was immensely dilated, sacculated and filled with pus. A portion of the ureter (the lower end of which opened into the posterior urethra) was removed at the same operation through a Gibson's incision. A secondary operation was necessary for the removal of the extreme lower portion of the ureter. The patient was cured. This is the only case found reported in which a complete and accurate pre-operative diagnosis was made in a male.

Successful nephrectomies are reported by Kakuschkin, Kallmann, Linck, Mueller, quoting Stolz and Nemenoff. These with the author's two cases, make a total of nine primary nephrectomies.

In the only instance in which the presence or absence of infection in the supernumerary portion of the kidney is emphasized Nemenoff reports a case operated on by Professor Schürchow who decided against implantation of the infected ureter into the bladder and resorted to a nephrectomy.

Two cases have come under the writer's personal observation.

A D. a woman age 32 married came under observation early in 1923 referred by Dr. Edgar E. Stewart of Great Neck, Long Island. The family history is negative. Both parents are alive and well. Patient had had typhoid fever when 8 years old. When 3 years old no urine was voided for a period of 3 days. Further details of this illness are unobtainable beyond the statement from the patient's

Baum through the same type of approach cut through the posterior wall of the bladder into the aberrant ureter and sutured the edges of bladder and ureter. The incontinence was cured, but a vesical calculus formed and was removed some months later.

*Implantation* Implantation of the supernumerary or single ureter into the bladder through a vaginal approach is reported in 18 cases, through a suprapubic approach in 8 cases and a subpubic approach in 1 case making a total of 27 cases thus treated.

In the light of our present-day knowledge there would seem to be no excuse for the subpubic operation. Colzi reports one such operation in a girl of 15 years. A curved incision was made with its convexity upward through the soft parts close to the pubic arch and the vagina and urethra retracted downward. The bladder and ureter were exposed but because of the limited space the lower border of the pubic arch was chiseled off and the ureter was then implanted into the vagina. The patient is reported cured.

*Vaginal implantation* Albarran made a vaginal approach and sutured the edges of a wide anastomosis between the bladder and the supernumerary ureter successfully after a previous suprapubic anastomosis had failed.

Baker reports section and implantation of the end of the ureter into the bladder but 2 months later could not pass a probe into the ureter. Baker also reports the attempt of Dr Emmett to form a canal by enfolding the vaginal mucosa from a position high in the vagina where the ectopic ureter opened, to a point where a junction could be made with the bladder. This attempt was not successful and this procedure would not be considered.

Benckiser performed a two stage operation. The first established a connection between the bladder and the supernumerary left ureter followed 4 weeks later by the closing of the vaginal portion of the fistula. Result cured.

Davenport reports an implantation of a dilated right ureter followed by a secondary operation to close the persisting fistula. Cured.

Fromme reports an implantation followed by a cure.

Furness reports an unsuccessful anastomosis between the bladder and ureter, the incontinence

reappearing 4 days after the operation. At a second operation the lower end of the ureter was drawn into the bladder by traction upon a suture introduced through the urethra and the ureter was sutured to the bladder wall. The incontinence ceased but 3 weeks later after the intravenous use of indigo carmine none could be seen coming from the newly formed ureteral orifice in the bladder nor could the supernumerary ureter be catheterized.

J. P. Hartmann reports a successful implantation in a woman incontinent after the birth of a child.

Job Hartman reports a successful implantation of the lower end of a supernumerary ureter into the bladder.

Hohmeier reports a successful implantation of a right supernumerary ureter.

Jaffe reports one successful implantation of a right supernumerary ureter.

Kelly and Burnam report two cases cured by a longitudinal incision through the anterior vaginal wall and the posterior or approximate wall of the supernumerary ureter followed by another like incision through the anterior wall of the ureter into the bladder with careful approximation of the edges of bladder and ureter after which the primary incision through the vagina was closed.

McArthur successfully implanted the cut end of a ureter into the bladder after another surgeon at a previous operation had failed to control the incontinence.

Maxson reports a case in which the ureter was cut across and the end drawn into the bladder by traction on a suture introduced through the urethra, the ureter then being fixed to the bladder by sutures. This case is reported cured but a recurrence of the incontinence several years later after the birth of a child is reported by Judd.

Olshausen reports a case in which the supernumerary ureter was first sutured into the urethra. This operation was followed by fever and pain in the right side. At a second operation the ureter was implanted into the bladder but three additional plastic operations were necessary to cure the incontinence. The patient is reported entirely well 5 years after operation.



Fig. 1. Opaque catheter introduced through the ectopic opening alongside of the external meatus coiled up in dilated left supernumerary ureter behind and above the symphysis pubis.

inadvisable because of the infection present in the supernumerary kidney. Ligation of the ureter was discarded for the same reason. Exploration of the kidney was decided upon with the hope of finding a condition that would permit a heminephrectomy. The alternative was a nephrectomy.

Operation was done February 7, 1923. Patient was placed on her right side with a kidney bag under the flank. Incision was made from in front of the left anterior superior iliac spine upward and backward to end above the twelfth rib 3 inches from mid line of back through skin, fascia and muscles exposing the perirenal space. The kidney capsule was opened and the kidney was freed without difficulty and delivered into the wound for examination.

Two ureters each with a separate pelvis were found to come from a single kidney. A very small ureter approximately the size of an eighteen gauge hypodermic needle drained the lower pelvis. This ureter was situated behind and at the left or outer side of a very large supernumerary ureter draining the cephalic portion of the kidney. The vascular pedicle entered the kidney close to the upper pelvis and there was an entire absence of any vascular pedicle directly to the lower portion of the kidney. It was readily apparent that the distribution of the blood vessels precluded a heminephrectomy and the operation was finished as a nephrectomy. Without any particular technical difficulty the kidney was



Fig. 2. Normal right pelvis, lower pelvis of the left kidney and lower portion of the supernumerary left ureter.

removed the operation differing from the usual nephrectomy only in the necessity of removing two ureters. The smaller lower ureter was divided between ligatures and the lower end dropped into the ground. The larger ureter was freed by blunt dissection down as far as could be reached, there divided between ligatures and the wound closed in the usual manner using chromic gut sutures for the muscles silk for the skin and silkworm gut tension sutures. A wrapped gauze drain was inserted for drainage.

The patient was then turned on her back and an incision corresponding to an intramuscular appendectomy approach was made down to the peritoneum on the left side. This was pushed forward and upward exposing the supernumerary ureter which was readily recognized. The ureter was freed until the upper end was brought out of the wound after which the dissection was continued downward to just above the upper border of the symphysis. Here this ureter was ligated and divided with the cautery. A wrapped gauze drain was inserted down to the stump of the ureter and the wound closed.

mother that after taking some medicine prescribed by a physician the condition cleared up and the patient was as well as ever. She has been married 6 years has been pregnant twice each time going to full term without complications. Both deliveries were normal and the children one 5 years old the other 3 are living and in very good health. Her menstrual history is negative.

**Chief complaint** As far back as she can remember it has been necessary to wear a napkin because of constant leakage of urine and her mother states that as a child she was never dry. The wetting has been continuous day and night and as far as the patient has observed not influenced by posture, bodily activity or any other factor. As a rule the flow has been a gradual drop by drop secretion the amount of moisture on the napkin depending upon the length of time worn. On rare occasions there has been a marked increase in the quantity of the leakage. No particular cause has ever been noted to explain these unusual fluxes.

The act of urination is always normal and without undue frequency or urgency, a normal desire to urinate occurs at regular intervals, there is no dysuria and normal relief is experienced after the bladder is emptied. The leakage is independent of and not influenced by urination and is just as rapid immediately after urination as at any other time.

**Physical examination** Patient is a well developed and well nourished young woman of strong physique. Nothing of pathological importance was discovered in the routine examination of the chest and abdomen. The pelvis is negative. The left side of the external meatus is oedematous but not congested. The external genitals are moist and when dried quickly become moist again, the dampness first appearing near the urinary meatus. A catheter can be passed into the bladder readily and clear urine is obtained. While the catheter remains in the urethra the genitals are dry but moisture appears again immediately after withdrawal of the catheter. Visual examination of the vagina and cervix is negative except that the patient remains entirely dry while the speculum is in place but becomes wet immediately after the speculum is withdrawn. As it afterward developed the supernumerary ureter is situated to the left of the urethra so that pressure from either a catheter in the urethra or a speculum in the vagina is sufficient to prevent the escape of fluid from the ectopic opening. With good exposure and light a small drop of fluid can be seen to form in the oedematous mucosa contiguous to the left lip of the meatus and at this point a No. 5 F ureteral catheter can be introduced into a small opening. The catheter passes its entire length 50 centimeters. Turbid fluid immediately flows through the catheter and with an aspiration syringe 30 cubic centimeters of the fluid is obtained, this fluid becoming progressively more turbid as the aspiration progresses until at the end it is purulent.

Cystoscopic examination shows a normal bladder with normal right and left ureteral orifices. Each

ureter is readily catheterized, the catheters pass up the usual distance and no obstructions are noted. Neither pelvis contains residual urine. The flow of urine from either catheter is intermittent in character and rapid in rate and the urine is clear in gross appearance in marked contrast to that obtained through the catheter in the ectopic opening.

Salt solution deeply colored with methylene blue was introduced into the bladder while negative pressure was maintained through the third catheter in an attempt to demonstrate a connection between the bladder and the anomalous opening, but none of the dye comes through the catheter. Salt solution deeply stained with mercurochrome was then injected through the ureteral catheters into each pelvis and these catheters withdrawn. Again no color can be found in the fluid coming from the remaining catheter.

At this stage of the examination it is possible to diagnose a supernumerary ectopic ureter coming either from a separate third kidney or from a kidney with two separate and non-communicating pelves.

A roentgenogram Figure 1 shows that the catheter in the supernumerary ureter lies curled up in a circle of small radius just above the upper border of the symphysis, the entire length of the catheter having curled up in this area. A roentgenogram made after injecting a 25 per cent solution of sodium iodide into the supernumerary ureter shows an enormously dilated and sacculated ureter on the left side (Fig. 3). The ureter appears to end in a globular sacculcation, the upper portion of which reaches to about the level of the upper border of the sacrum. Beyond this point the injected fluid does not ascend. The strictured portion of the ureter discovered after operation explains the failure of the opaque fluid to reach a higher level.

The left normal pelvis is very small with but two calyces. The left ureter is also very small but normal in position in its course from the pelvis to the bladder.

A pyelo ureterogram shows the right pelvis to be in normal position and of normal size and outline and the right ureter of normal size and position throughout its course from the pelvis to the bladder (Fig. 2).

Urinaly is by Dr. Cyrus W. Field

	Right	Left	P <sup>1</sup>	S <sup>1</sup>	per n	ry
Ammonia	018	016	030			
Sodium chloride	7 0	650	390			
Urea	840	780	430			
Uric Acid	0 6	024	015			
Creatinin	047	040	020			
Blood	None	None	None			
Fos	None	None	Very much			
Culture	Sterile	Sterile	Bac. coli communis			

**Diagnosis** Supernumerary ureter opening near external urinary meatus. The supernumerary kidney or cephalic portion of the left kidney shows marked infection and poor functional activity.

**Choice of operation** Implantation of the supernumerary ureter into the bladder was considered



FIG. 7. One catheter introduced through the ectopic opening is coiled above the symphysis. The other catheter introduced through the bladder is in the left ureter.

middle explains why the sodium iodide solution injected in making the pyelogram failed to pass upward beyond the level of the upper border of the sacrum (Fig. 5). The lower pelvis is normal in size but its ureter is very small, the lumen admitting with difficulty a No. 18 gauge needle. A single vascular pedicle enters the kidney close to the cephalic pelvis. There is no line of demarcation showing the attachment of the supernumerary portion to the normal kidney.

**Microscopic examination by Dr William Crawford II, M.D.** Sections show a congestion within the glomeruli and degeneration of the tubules almost resembling cloudy swelling. Some areas are free but there are many sections in which the tubules take the stain very poorly and the lumen is packed with a granular detritus. There are areas of hyalineization in the cortex. Section of the accessory ureter shows a great thickening of the wall with the deposit of some round cells and with a large deposit of detritus in the lumen.

**Pathological diagnosis:** Chronic nephritis, one normal ureter, chronic inflammation of accessory ureter.

**CASE 2.** D. T. is a 14-year-old school girl who has always been a normal active and healthy child in every way except for urinary incontinence. Her mother reports that she has never been dry from the time of her birth although at the usual age she exhibited normal control of stool and urine. Urination



FIG. 8. Roentgenogram showing the supernumerary right pelvis, the upper and lower sections of the supernumerary ureter and the normal right pelvis filled with a solution of sodium iodide and an opaque catheter in the normal right ureter.

is voluntary at regular intervals in response to the usual demand and is followed by the usual relief. A continuous leakage goes on without any relation to urination and is not influenced in any way by the latter. The history is that typical of an ectopic opening of the ureter.

**Physical examination** is entirely negative except for cystoscopic and radiographic findings.

**Cystoscopic examination.** Bladder tolerance, bladder capacity, the bladder mucosa, trigone and ureteral orifices are all normal. Catheters pass to either pelvis readily, no obstruction being noted. The flow of urine begins from each side immediately and is normally intermittent in character and rapid in rate. The urine is clear in gross appearance. There is no residual urine in either pelvis. Pyelograms of either side show the pelvis to be of normal position, shape, and size. Externally just to the right of the external urinary meatus there is a very small opening from

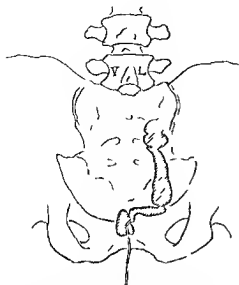


Fig 3 Tracing made from roentgenogram showing accumulated and dilated supernumerary left ureter the injected fluid reaching only part way up the ureter

The kidney measures 11.5 by 4 by 7 centimeters and has attached to it two small ureters one at the caudal extremity and the other at the cephalic end (Fig 4). The external markings of the kidney are normal except for a small cyst of the lower pole.



Fig 4 Roentgenogram taken after removal of the kidney showing the normal lower pelvis with a small ureter and the small upper supernumerary pelvis with the greatly dilated ureter

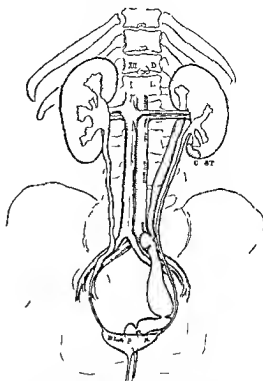


Fig 6 Diagrammatic reproduction of structures as found by examination and at operation showing supernumerary and normal kidney pelvises and ureters

The kidney has two pelvises. The cephalic pelvis is small and situated on the inner upper aspect of the superior pole. The ureter from this pelvis is more than 1.5 centimeters in diameter at the upper end and is alternately accumulated and constricted throughout its length. A small stricture at about its



Fig 5 Dilated supernumerary ureter with constriction at about its middle. Because of this constriction the sodium iodide solution failed to pass upward beyond the level of the upper border of the sacrum.

freed upward until the cut end could be brought out of the wound then downward to the posterior aspect of the symphysis where it was cut between ligatures. Rubber tissue drain was inserted down to this point.

**Pathological report.** Specimen consists of a kidney measuring 1.5 by 6.5 by 4 centimeters. The greater part of the kidney is of normal appearance but a separate and extra ureter enters the upper pole of the kidney and there opens into the small pelvis which drains the parenchyma of the extreme upper end. There is no sharp dividing line in the gross between the kidney tissues drained by the two ureters. The kidney parenchyma appears quite normal in the gross except that the parenchyma over the supernumerary pelvis is thinned out. The mucosa of the normal pelvis shows many small hemorrhages.

**Microscopic examination by Dr. William Crawford White.** Sections were cut through the kidney parenchyma draining into the normal and accessory pelvis. There is no marked difference in the kidney tissue in these two areas. Some of the convoluted and straight tubules were moderately dilated and lined by compressed more or less degenerated cells but on the whole the epithelial elements were well preserved. The glomeruli were normal only occasionally was a dilated glomerular space with a shrunken vascular loop encountered. There was no inflammatory reaction present though in the immediate neighborhood of the minor calyces and the accessory pelvis many of the collecting tubes had atrophied and were replaced by connective tissue.

**Diagnosis.** Mild parenchymatous nephritis in kidney with accessory pelvis and ureter.

A review of the literature has resulted in finding 98 reported cases these with the two here reported make a total of one hundred in all. These have been arranged in tables according to the type of anomaly as follows:

Table I. Single ureter with ectopic opening

Table II. Complete unilateral duplication of pelvis and ureter with an ectopic opening of the supernumerary ureter

Table III. Complete unilateral duplication of pelvis and ureter with ectopic opening of both ureters

Table IV. Supernumerary kidney pelvis and ureter with an ectopic opening

Table V. Bilateral duplication of pelvis and ureters with one ectopic opening only

Table VI. Bilateral duplication of pelvis and ureters with bilateral ectopic openings

Table VII. Both single ureters having ectopic openings

It is to be noted that 65 cases have been reported as occurring in females and 35 in the male a ratio of practically 2 to 1. Of the

female cases reported but nine were found at autopsy the remainder are reported as operations or examinations while in the male cases reported 33 are autopsy reports. A diagnosis was made in the living male in only 2 cases.

TABLE I—SINGLE URETER WITH ECTOPIC OPENING

Report	Case	Age	Operation	Remarks
Baker	F		Oper. 11	Oper. 1 by T. A. Em.
Baker	F		Oper. 11	Oper. 1 by T. A. Em.
Baker	F	5	E. m. nat.	Case 1. K. m. th. E. m. nat.
Baker	F		A. t. p. y.	Case 1. K. m. th. E. m. nat.
Baker	M		A. t. p. y.	Case 1. K. m. th. E. m. nat.
C. m. u.	M		A. t. p. y.	Case 1. K. m. th. E. m. nat.
Ch. hu.	M		A. t. p. y.	Case 1. K. m. th. E. m. nat.
C. la.	F	5	Oper. 11	Case 1. K. m. th. E. m. nat.
Dav. po. t.	F	20	Oper. 11	Case 1. K. m. th. E. m. nat.
D. y.	M		Oper. 11	Case 1. K. m. th. E. m. nat.
Eppinger	M	2	Autopsy	Case 1. K. m. th. E. m. nat.
Gruber	M		A. t. p. y.	Case 1. K. m. th. E. m. nat.
Hann	F	26	Oper. 11	Case 1. K. m. th. E. m. nat.
J. d. l.	F	2	Operation	Case 1. K. m. th. E. m. nat.
M. d. d.	F	16	Exam. n. t.	Case 1. K. m. th. E. m. nat.
W. e. t.	M	16	A. t. p. y.	Case 1. K. m. th. E. m. nat.
W. e. t.	F	27	Oper. 1	Case 1. K. m. th. E. m. nat.
W. e. t.	F	27	Oper. 1	Case 1. K. m. th. E. m. nat.
McArthur	F	2	Operation	Case 1. K. m. th. E. m. nat.
M. e. n.	M		A. t. p. y.	Case 1. K. m. th. E. m. nat.
Nach. J. ch.	M	4	A. t. p. y.	Case 1. K. m. th. E. m. nat.
P.	F	6	Oper. 11	Case 1. K. m. th. E. m. nat.
R. t. t. h.	M	3	A. t. p. y.	Case 1. K. m. th. E. m. nat.
Schw. 1.	F	2	Oper. 1	Case 1. K. m. th. E. m. nat.
V. M. e. n.	F	4	A. t. p. y.	Case 1. K. m. th. E. m. nat.



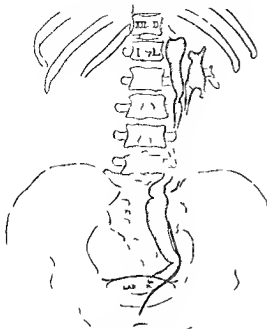


Fig. 9. Reproduction from roentgenogram of supernumerary and normal right pelves and ureters.

which fluid escapes drop by drop. After considerable difficulty a small ureteral catheter was passed into this opening and a large amount of light colored slightly turbid urine was aspirated. The catheterization of this supernumerary ureter caused very considerable pain to the patient; the only pain complained of during the examinations. During the catheterization of the accessory ureter colored fluid was successively injected into the bladder, left kidney, and right kidney without any of the color appearing in the urine from the extra ureter (Fig. 7).

The ureterogram of the supernumerary ureter shows a large dilated ureter extending from behind the symphysis up the right side to the level of the upper border of the sacrum where the outline is lost to reappear at the level of the lower border of the

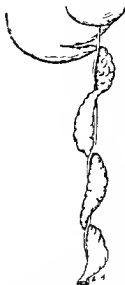


Fig. 10. The alternately dilated and constricted supernumerary ureter winding about the normal ureter. (From Bailey and Veau.)

third lumbar vertebra then extending upward as a funnel shaped tube large above (inside and above the normal right ureter and pelvis) evidently opening into the upper part of the right kidney (Fig. 8). There are none of the usual markings of calyces.

**Operation.** The usual kidney incision was made through the skin, fascia and muscles exposing the right kidney. The kidney was freed with finger dissection delivered and the lower ureter readily identified. The supernumerary ureter attached to the upper pole of the kidney was identified as a very large tube and the vascular pedicle was isolated and found to enter the kidney at a point about midway between the ureter. There was no line of demarcation marking the kidney off into separate portions and it was decided that a total nephrectomy would be safer under the circumstances than an attempt to do a heminephrectomy. The lower ureter was divided between ligature and the distal end dropped back into the wound. The larger ureter was then freed down as far as possible and cut between ligatures. The vascular pedicle was ligated with No. 2 chromic catgut ligatures. No clamp were necessary as the exposure was very good and it was possible to ligate the vessel separately. The kidney was then removed. The incision was closed in the usual way. A rubber tissue drain was placed down to the stump of the pedicle.

The patient was then turned on her back and an intramuscular incision made corresponding to that used for an appendectomy the peritoneum pushed forward and the two ureters readily identified—the supernumerary ureter being posterior to the normal one. The supernumerary ureter was then

	Left	Right	Normal
Color	Lemon	Lemon	Lemon
Sediment	Slight	Slight	Slight
Reaction	Alkaline	Neutral	9 N/10 acid
Ammonia	0.0061%	0.0024%	0.0034%
Urea	340	296	221
Uric Acid	009	005	004
Creatinin	013	0097	003
Na C	21	23	57
Albumen	None	None	Very faint trace
Pus	None	None	Few
Casts	None	None	None
Epithelial Cells	Few	Few	Few
Culture	Sterile	Sterile	40 colonies B. coli per c. cm. urine

TABLE II—Continued

R p o r t	Sex	Age	Oper	R m k
Th m	F	3	Ope t	Right perm m y ur d d p e sa Tb t f p d l t h d t d a d w c red by r m t f s perm m t ry t y uret
T y	F		Operat n	Sperm m y uret
Wed ky	M	5	A topsy	Right perm m ry et pen d th p t u th
W th am	F	8	Operatio	E m t o %
W H	F	1	E m t o	% mer ry ur let t t t d l
W H	F		Ope too	t th l b m m

TABLE III—COMPLETE UNILATERAL DUPLICATION BOTH URETERS ECTOPIC OPENINGS

Report	Sex	Age	Oper	R m k
Ol	M	55	A t psy	B th ght i r s p e d th post so ur
R h	M	69	A t psy	B th t t t p e d t d l d i t m

TABLE IV—SUPERNUMERARY KIDNEYS  
URETERS AND PELVES

R port	Sex	Age	Oper	R m k
S m l k d c h	F	9	Ope t	C m p l t l i r a t d p l t u r t p e l d k t y A k y m ry ght k l y b o o th k l y b perm m ry et p s t h g d d y d s r a t t t p e d th g l
I e	F	3	Ope u	R m t h s e p a t d d y d s r a t t t p e d th g l

TABLE V—BILATERAL DUPLICATION OF PELVES  
AND URETERS ONE ECTOPIC OPENING

Report	Sex	Age	Oper	R m k
Al b e g	F	8	Ope u	Right perm m ry t De th l m s e p t l o w g t t m p t t r p a k t Right perm m y ter p e d t th g l t t d e d t m p r u l t p y l
Con tze	F		A t psy	Right perm m y ter p e d t th g l t t d e d t m p r u l t p y l
H n d l	M	9	A t psy	Right perm m y t o r u r th Th ght perm m ry t t d m m t t h b t d u l t r y d u c t th d o c o f th p r o n t h
H u n t i n g t o n	M	5	A t psy	Th ght perm m ry t t d m m t t h b t d u l t r y d u c t th d o c o f th p r o n t h
K o e p f l m b	F	4	A t psy	Th ght perm m ry ur t f i l l e d w th p u s o w e d v a c u a

TABLE V—Continued

R p o r t	Sex	Age	Oper	R m k
M d l g	F	25	E m t	Left s perm m ry t p e d t the
M e s t y a n d	M		A t psy	Left perm m rary e t p e d t o p s t a t t h a a l t e r p a s s g t h r o u g h t h p t t
M y	F	24	A t psy	Right p u m e r y t p d i n t h t h r
P o c k	M	9 mos	A t psy	Right s per m ry ur t p e l n the p r o s t a t c u n e h p e m r y u r d i s o b l d
R u m p e l	F		A topsy	Right s p u m a r y ur t o p e d t th d o f th t t l ur y m t
T a d l	M	8	A t psy	Left p e d t h p o t e r t h
W h	M	30	A t psy	Th p m y a h t ur t p u r t h p o s t s o u r t h R a h t p e d m r y t t e p e d m r y t e r u r t h t w o l f t t r s
W a g e r t	M		A t psy	R a h t p e d m r y ur t p e d m r y t e r u r t h t w o l f t t r s
Z l k y	M		A t psy	R a h t p e d m r y ur t p e d m r y t e r u r t h t w o l f t t r s

TABLE VI—COMPLETE BILATERAL DUPLICATION OF PELVES AND URETERS WITH  
BILATERAL ECTOPIC OPENINGS

R p o r t	Sex	Age	Oper	R m k
S t a m m l	F		Ope t	B i t l m p l t d u p l t w i t h t w e c t p e s R a h t t h d f t h p e d t h t h f t p e l t h l f t j f t h e m t
A m m l a l G f	F	5	Ope at	

TABLE VII—BOTH SINGLE URETERS HAVING  
ECTOPIC OPENINGS

R p o r t	Sex	Age	Oper	R m k
B u n g	M		A t psy	R t h g l t h p o s t t p e d t t h p o s t o r t h B l a d i w b e t

TABLE VIII—TABULATION OF REPORTED CASES  
FOUND IN LITERATURE<sup>1</sup>

	Oper	F m l A t psy	F m t	Ope at	M l A t psy	T tal
T M I					0	4
T M II	37	4		0	3	55
T M III			0		0	
T M IV		4		0	8	4
T M V		0		0		
T M VI		0		0		
T M VII		0	4			
T t a s	51	0	4		11	

Th t h t w e s e s i n l u d d i n t h s t a b l

TABLE II—COMPLETE UNILATERAL DUPLICATION WITH ECTOPIC OPENING OF THE SUPERNUMERARY URETER

TABLE II—Continued

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Fig 3 Sagittal section of normal pelvis



Fig 4 Shows distention of tube

told that this was the condition) but further investigation proved this not to be true. Upon attempting to sweep the examining fingers across the head to ascertain its position it was discovered that the head while in the pelvis was not in the vagina. A thin membrane between the examining finger and the head thought at first to be the fetal membranes was found to be the septum between the vagina and Douglas pouch stretched to an almost incredible thinness. The cervix could not be felt. The head filled the pelvis to the level of the ischial spines (Fig 1). A diagnosis of extra uterine pregnancy at full term with a living child was made and an immediate delivery was agreed to. The patient was removed to the Maryland General Hospital and operated upon the same afternoon.

**Operation.** The abdomen was opened by a left median incision 15 centimeters in length extending equally above and below the umbilicus. When the abdomen was opened the tumor described as occupying the median line presented in the lower part of the incision and was found to be the enlarged uterus. Attached to the posterior surface of the uterus and extending laterally to either side was a quadrilateral mass about 12 by 16 centimeters. This was the placenta which was attached chiefly to the posterior surface of the broad ligaments and the posterior surface of the uterus. There were some small extensions of the placenta to the right side attached to the

mesentery and folds of small intestine by light adhesions. Extending from the upper border of the placental mass was the thin fetal sac (Fig 2). On the right side the fallopian tube could be seen extending along the upper border. The left tube was not visible but was apparently incorporated in the mass. The sac was opened and the left foot which had been felt at the external examination presented. The child was delivered and seen to be a well developed normal child. It weighed 8½ pounds. When the sac had been emptied it was decided that the placental mass could be removed entire or nearly so if the uterus were removed at the same time. This was done after tying off several adhesions to the intestines. There was very little bleeding. The incision was closed with two iodoform cigarette drains for drainage.

The patient made a good recovery, the only complication being a slight infection of the incision. I think this was probably due to the drains which might have been omitted with advantage. She was discharged on the twenty eighth day entirely well. The baby was also in good condition except for a stricture of the pylorus from which it apparently entirely recovered. It is now living and well.

The most interesting feature of this case it seems to me is the complete descent of the head into the pelvis—indeed the development of the head must have been entirely in the pelvis. One can hardly account for the

## EXTRA-UTERINE PREGNANCY AT FULL TERM

By J. M. H. ROWLAND, M.D., F.A.C.S., BALTIMORE

Professor of Obstetrics, University of Maryland School of Medicine

**E**XTRA-UTERINE pregnancy at full term with a living child is relatively so rare that I wish to report the following case:

**CASE.** On February 2, 1921, I was called to see Mrs. L. R., age 39, para 11. At this time she was reported to have been in labor for 2 days, apparently at full term. The family history was negative; her childhood and early life had been normal; there was no history of pelvic disease. Her first pregnancy and labor, which had occurred 13 years before, had been normal; the child was still living and in good health. Subsequent menstrual history was normal until May 15, 1920, when last normal menstruation occurred.

**Present pregnancy.** In June 1920, she had a profuse discharge, dark in color and with a rather offensive odor, but without pain. There is no history of pain at the time of this first discharge or during the next few weeks. In July or August (she was uncertain as to the exact time) she began to have cramplike pains in the lower abdomen and on several occasions felt quite faint. Since the first attacks of pain, she had had no faintness but had suffered almost constantly some discomfort in her lower abdomen, usually associated with frequent and more or less painful urination.

**Physical examination** showed a well developed rather stout woman with negative findings except in the abdomen and pelvis. The abdomen was quite distended, smooth and symmetrical, giving on inspection the appearance one sees in cases of pronounced hydramnios or twin pregnancy at term. On palpation the tense and thick abdominal wall prevented the obtaining of fetal outlines, though what was thought to be a foot was felt on the left side above the level of the umbilicus. In the median line, extending from the symphysis nearly to the umbilicus and pressed firmly against the abdominal wall, was a tumor mass which could easily be measured about 7 by 12 centimeters. The fetal heart could be heard distinctly on the right side, far back, below the level of the umbilicus.

**Aginal examination** showed the presenting part, the head, occupying the pelvis. At first it seemed to be a case in which the head had descended to the pelvic floor after complete dilatation (when called to the case, I had been



Fig. 1. Shows the relation of the child at the time of the first examination.

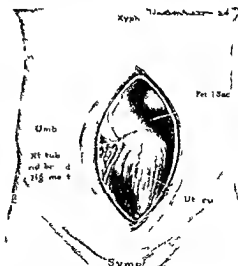


Fig. 2. Shows the abdomen opened with the enlarged uterus, right tube, and fetal sac.

## EXPERIMENTAL NEPHROTOMIES

BY WILLIAM JAMES CARSON M.D. BALTIMORE MARYLAND  
 From the Department of Pathology, University of Maryland

## METHOD OF EXPERIMENTATION

MOORE and Corbett (6, 7) studied experimentally the damage done to the kidney by operation with a study of the loss of function resulting from such procedure. Some of their conclusions were as follows: (1) An operation on the kidney always destroys a certain amount of kidney substance. (2) The section of the kidney does less harm than the suture necessary to control hemorrhage. (3) The suture of the capsule alone is not sufficient to control the hemorrhage. (4) The destruction of the kidney extends far beyond the site of operation. (5) Functional activity of the kidney is somewhat reduced. (6) Histologically great damage is done to the kidney substance.

Magoun in 26 experimental nephrotomies on 23 dogs concluded that in 14 of his experiments there was a reduction in the function of the kidney and that this reduction was in proportion to the amount of kidney tissue destroyed. In these 14 cases the following complications were observed: uræmia 7, hemorrhage 2, stone formation 4. Realizing that hemorrhage is one of the chief complications of nephrotomy, various methods of suturing the kidney were recommended by Moore and Corbett (6, 7), Rehn (1921, 8), Cimnata (192, 3), Jianu (1922, 4), Magoun (193, 5) and Beer (1923, 1).

Carson and Goldstein (2) performed 14 nephrotomies on 7 dogs and 7 rabbits in which no sutures were used; the kidney halves being approximated and held under light pressure until bleeding ceased without encountering postoperative hemorrhage, fistula, uræmia or stone formation. The histological study of nephrotomized kidneys without sutures demonstrated a minimum destruction of kidney tissue. Realizing that nephrotomy without sutures is a radical procedure and hoping to secure a method which would tend to minimize the element of danger, the author performed the following experiments:

The experiments were performed on 18 dogs. In Group 1, 16 dogs were used. In Group 2, 7 dogs used in Group 1 were returned for a third operation and 7 were used upon which a nephrectomy had previously been performed. All of the operations were performed under ether anesthesia with sterile technique. The kidneys were delivered through a lumbar incision and the perirenal fat stripped in all cases. In Group 1 the peritoneum was torn in dogs Nos. 14 and 29, and in Group 2 in dog No. 5 this was closed with catgut before the kidney was sectioned. No clamps were used on the renal vessels in any case. A scalpel was used in all cases for making the incision. In each experiment the kidney was incised from pole to pole down to the pelvis in the midline. The bleeding surfaces were sponged quickly so that the architecture of the kidney could be observed. The cut surfaces of the kidney were then approximated and held together by light pressure, while interrupted Cushing sutures (No. 6 plain catgut) were introduced into the capsule, without injuring the kidney with the needle. All sutures were tied under slight tension. The time elapsing between the approximation of the kidney halves and the cessation of bleeding was recorded as the bleeding time. After the bleeding ceased the kidney was watched for 15 minutes before it was replaced into its pocket and then again observed for from 5 to 10 minutes before the wound was closed. The wound was closed by the layer method with No. 1 chromic catgut. All wounds were closed tightly with cotton and collodion dressings. All animals recovered from anesthesia within 15 minutes from the time ether was discontinued. After being returned to their cages they were watched carefully for blood in the urine. In 24 of the 25 experiments there was no blood in the urine after the fourth day. They were kept on a liquid diet for 2 or 3 days. The first day after operation the ani-





Figs. 5 and 6 Showing how the pelvic development of the head probably acted to prevent the downward growth of placenta

extreme stretching of the thin partition in front of the child's head or think it possible except as the result of a very slow distention (Fig. 1). The uterus had been entirely displaced no portion of it being in the pelvis. The pain and discomfort reported as being present after the first few weeks largely referred to the bladder and continuing throughout pregnancy after the first two months were no doubt due to the displacement of the bladder and constant pressure by reason of the pelvic position of the head. It requires no great stretch of the imagination to think of the very thin membrane covering the head being mistaken for the bag of waters with its consequent artificial rupture and the delivery of the child through the vagina.

Another interesting feature was the development of the placenta which with the exception of a few small extensions was an almost exact quadrilateral mass. The very fortunate failure of the lower border to spread over the pelvic floor was due no doubt to the pressure applied in an upward direction by the pelvic development of the head.

The decision to operate immediately was due to the fact that the child was evidently fully developed, alive and in good condition. Statistics show that a large number of children survive the operation and this makes it important that the interest of the child should

not be disregarded. The mortality in operations at term is very little increased over that in operations of a later date. Beck in a very complete review of this condition expresses the opinion that allowing the pregnancy to continue with the resulting death of the child with the expectation of an easier and safer delivery later may eventuate in equal difficulties at delivery, an uncertain period of ill health for the mother and usually shows only a slightly decreased mortality.

Immediate operation in such cases as that reported above gives the certainty of a living child. This is somewhat offset by the fact that a relatively large percentage of these children are deformed.

This case illustrates the importance of a very careful supervision of pregnant women and a proper regard for a history of irregular bleeding occurring early in pregnancy, especially if accompanied by pain in a case which does not eventuate in miscarriage. Early pelvic examination in such a case could not help but demonstrate the nature of it as a part of the fetus which could easily have been felt occupied the pelvis after the first few weeks. A pelvic examination at any time before labor must have disclosed the absence of the cervix. In this particular case the physician was not called until labor had set in because of the Christian Science prejudices of the parents.



Fig. 3 Right kidney dog No. 22 120 days

Fig. 4 Photomicrograph right kidney dog No. 22

Fig. 5 Left kidney dog No. 5 66 days

Eight were sacrificed from 16 to 120 days after the nephrotomy. Gross examination of these 8 kidneys showed the line of incision to be occupied by a scar 1 to 2 millimeters in width and of a yellowish gray color the striate lines on each side of the scar being distinct in outline. In no instance was there any complication such as infarct postoperative uremia stone formation or fistula.

**Microscopical results in Group 2.** In the nephrotomized kidney of 14 days (Figure 2) the line of incision is occupied by scar tissue 1 to 2 millimeters in width. The fibroblasts are seen entering the line of incision from the capsule and from the interstitial tissue on each side. There is a moderate thickening of the interstitial tissue for a distance of 1 millimeter on each side of the scar line. The glomeruli on each side are moderately swollen with their epithelial and endothelial cells well stained. The tubules in close proximity to the scar are dilated with their epithelial cells well preserved. In several areas the tubules show their epithelial cells to be swollen and finely granular in appearance. An organized blood clot is seen distending the major and minor calyces.

Section from the nephrotomized kidney of 16 days shows the line of incision occupied by a large number of young fibrous connective tissue cells mononuclear wandering cells a few polymorphonuclear leucocytes small round cells and a few poorly stained red blood cells. New formed blood vessels are seen distended by red blood cells and a few

leucocytes. The interstitial tissue on each side for a distance of 1 millimeter is edematous. Glomerular tufts and tubules are poorly stained for 1 millimeter on each side of the scar line. Beyond this the kidney shows no changes. Nephrotomized kidneys of 35 days and thereafter show the line of incision to be occupied by scar tissue averaging 1 millimeter in width, and the interstitial tissue to be thickened for 0.5 to 1 millimeter on each side. New formed blood vessels are seen moderately distended by blood. The tufts and tubules in close proximity to the scar line are well preserved. Beyond this the sections appear the same as the controls.

#### DISCUSSION

Since the work of Moore and Corbett (6) demonstrated conclusively that sutures in the kidney substance destroy more tissue than the section into it and in a previous communication we (2) showed that nephrotomy without sutures destroys a minimum amount of kidney substance it seemed advisable to find a method which would appear rational and yet preserve the maximum amount of kidney tissue therefore the above experiments were carried out to ascertain the value of interrupted sutures in the capsule.

In the 25 nephrotomies performed with interrupted sutures in the capsule postoperative hemorrhage occurred in 1 instance (4 per cent Dog 14 Chart 2). As the dog was still active on the fourteenth day and examination of the kidney showed a scar in the line



Fig 1 (left) Right kidney log No 14 14 days

Fig 2 Photomicrograph right kidney dog No 14

imals were always allowed to run. In Group 1 they were returned for a second operation in 12 instances the time varying from 4 to 66 days. At this time a nephrectomy was performed on the kidney that was first nephrotomized. Three of the dogs were sacrificed at this time to obtain the other kidney for control. In Group 2 each dog was sacrificed in from 14 to 120 days. All of the kidneys were studied grossly and microscopically.

#### RESULTS

**Gross results in Group 1.** In the 16 nephrotomies on dogs with both kidneys from 3 to 5 sutures were used average 3.6. The bleeding time varied from 2 to 15 minutes average 5.4 minutes. The thickness of the blood clot between the kidney halves varied from 2 to 5 millimeters at the time the kidney was returned to its pocket. Gross examination of these kidneys on cross section show the line of incision up to 15 days to measure 3 to 5 millimeters in width being yellowish red in color. The striate lines of the kidney in each instance were visible at the edge of the organized blood clot. From 15 to 266 days the scar line varied from 1 to 5 millimeters in width being grayish white in color with the striate lines visible at the edge of this scar line. Four of the 16 dogs died: 1 on the fourth day from peritonitis, 3 from lobular pneumonia on the fifteenth, twenty-ninth and thirty-first day respectively. Three were sacrificed to obtain the other kidney for control. In no instance was there any complication such as infarct, postoperative hemorrhage, uræmia, stone formation or fistula.

**Microscopical results in Group 1.** In the nephrotomized kidneys up to 10 days the line of incision is occupied by an organized blood clot and connective tissue fibers are seen entering the line of incision from the capsule and from the interstitial tissue on each side. The glomeruli and tubules in close proximity to the blood clot are fairly well preserved with well stained nuclei. New formed blood vessels are seen. In the nephrotomized kidney of 15 days the line of incision is occupied by young connective tissue cells which are well stained young blood vessels mononuclear wandering cells small round cells a few poorly stained red blood cells and a moderate amount of hæmosiderin. Nephrotomized kidneys of 24 days and thereafter show the line of incision to be occupied by scar tissue averaging 1.7 millimeters in width with a thickening of the interstitial tissue due to fibrous connective tissue cells for a distance of 1 millimeter on each side with no disturbance to the remainder of the kidney.

**Gross results in Group 2.** In 9 nephrotomies on dogs from which one kidney had previously been removed from 3 to 5 sutures were used average 4.2. The bleeding time varied from 2 to 10 minutes average 4.8 minutes. In Dog 14 there was still blood in the uræ on the fourteenth day the dog had been as active as all others in these experiments and its general appearance showed it to be in good condition. When sacrificed the kidney, ureter and bladder were found to be distended with organized blood clot. The line of incision showed a scar of a yellowish gray color 2 to 3 millimeters in width (Figure 1).

- 3 Postoperative hæmorrhage was encountered in 1 case (4 per cent)
- 4 Histological study of the nephrotomized kidneys shows a minimum destruction of kidney substances

I am indebted to Professor Hugh R. Spencer for his valuable suggestions at all times

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## SPONTANEOUS RUPTURE OF THE OESOPHAGUS

BY T H WILLIAMS M.D. C.M. AND WILLIAM BOYD M.D. M.R.C.P. (EDIN.) WINNIPEG, CANADA  
From the Department of Pathology, University of Manitoba, and the Winnipeg General Hospital

**R**UPTURE of the oesophagus is of sufficiently rare occurrence to merit note. Since first Boerhaave reported the case of Admiral Baron Wassenair in 1724 there have been recorded in the literature 33 cases of spontaneous rupture of the oesophagus. It is not our purpose to review these cases here as full reviews may be seen in the papers of McWeeney, Bowles and Turner, Roy, Whipple and Menne.

Fitz in his paper held that except in two cases reported by Mayer and Allan and by Grammatzki up to that time no other cases had been definitely established of death having been caused by this condition. Sufficient cases have since been observed to demonstrate that spontaneous rupture of the oesophagus is a clinical entity and the immediate cause of death where it has occurred although most textbooks like Choyce, Charles, Ochsner, Keen, Warbasse are agreed that it seldom occurs apart from disease of the oesophagus usually called 'oesophago-malacia' and sometimes alcoholic oesophagitis.

While many have observed the pathological condition of the area where rupture has occurred and in some cases have reported adjacent areas denuded of epithelium and frequently remarked on the morbid condition of the oesophageal tissues there has been a

decided difference of opinion as to what extent these conditions are the predisposing cause of rupture and to what extent they are the result of postmortem changes.

Comparatively few histological findings have been reported apart from the excellent paper of McWeeney. Experimental work done by Mackenzie, Bowles and Turner and Broesch was designed to demonstrate the possibility of rupture by mechanical forces and the usual location of such rupture.

Having had an opportunity to observe recently a case of spontaneous rupture of the oesophagus and having made microscopic examination of the oesophagus and stomach we compared these findings with those observed after similar lesions of the oesophagus had been experimentally produced in two previously healthy animals. Sections were made in each case immediately at death and again after a period of 24 hours of postmortem degeneration in the cadaver to determine what degree of postmortem degeneration occurs due to autodigestion of the oesophagus and to what extent this can explain postmortem findings in cases of ruptured oesophagus.

## CASE REPORT

The patient as in so many of the reported cases was a man of alcoholic habits. He had always been fairly healthy until about 6 or 8 years ago when he

CHART I—INTERRUPTED SUTURES IN KIDNEY CAPSULE

D # N	Kidney	D t f ph t my	Su f k d y t eph t my (m)	N f s t es	Bleed t me (mm)	D t f ph ec t my	Su f k d y t ph t my (m)	W th f sc (mm)	D ys int ang	Blood in (d y)	R m k s
20	Right	6-9-24	6-5-3	5	4	6-3-4	6-5-3	4	4	4	Died from pe t int
34	Right	0-4-24	6-5-3	3	4	3-4	6-4-8	5		3	Sacrificed
2	Left	2-9-3	6-8	4	5	4-4	5-5	4	5	3	Died f m l b p mo- sa
4	Left	0-6-3	6-3-3	3	5	21-9-23	6-3-3-4	5	4	4	
16	Right	10-30-23	6-3	3	4	8-23	5-5-3-4	51-2	0	4	Died f m lobar p m
	Left	8-23	5-3-3	3	5	8-9-3	5-5		3	3	Died f m lob pneumo sa
	Left	4	6-3	3	4	4-3-4	6-4-3	2	43	4	
3	Left	7-3-24	5-3-8	5	4	9-4-4	5-3-5		60	3	Sacrificed
3	Left	7-4-4	6-2-4	3	4	10-4-6	6-2-3	5	0		
5	Left	4-4-4	7-2-4-3-5	4	5	8-4	7-2-3-5-3-8		00	3	
8	Right	6-18-4	6-5	4	4	0-9-4	5-5-5			5	
9	Left	8-2	7-5-4-3-3	3	8	3-5-4	7-2-4-3-4			4	
7	Right	5-8-4	5-5-3	5	4	0-8-4	5-5-5		3	3	
6	Right	5-4	6-5-3-3-3	4	5	10-3-4	6-2-4-8		56	3	Sacrificed
3	Left	3-0-4	6-2-4-3-6	4	4	10-2-4	6-2-4-2-4		05	3	
8	Left	3-10-23	5-5-3	5	8	2-0-23	6-3-3-3	2	66	3	Figure 5

P r i t u m p e d d i n g n e p h t o m y

CHART II—INTERRUPTED SUTURES IN KIDNEY CAPSULE OF DOGS FROM WHICH ONE KIDNEY HAD PREVIOUSLY BEEN REMOVED

D # N	Kidney	D t f ph t my	Su f k d y t eph t my (m)	N f s t es	Bleed t me (mm)	D t f sacrificed	Su f k d y t topay (m)	W th f sc (mm)	D ys int ang	Blood in (d ys)	R m k s
14	Right	3-6-4	5-4-5-4	4	4	3-0-4	6-2-6-5-5	20-3	3	2	Sacrificed
5	Right	3-4-4	5-2-4-3	4	5	3-10-4	6-2-4-3		6	4	
36	Left	2-4	5-2-4-3-6	5	4	5-5	7-2-4-5-5		33	3	
3	Left	1-6-4	7-3	6	5	5-5	7-3-5-5		6	3	
3	Right	5-4	7-2-4-3-4	5		5	7-2-4-5-5		7	4	
3	Right	4-4	5-2-4-3	3	4	2-3-5	6-5-3-5-3		8	3	
8	Left	3-4	6-5-3	6	5	2-0-5	6-8		90	3	
7	Left	5-4	7-2-4-3	5	6	3-5	5-8-3-4-3	2	00	4	
	Right	7-0-4	8-3-4	4	5	0-8-4	7-5-5-4			3	Figure 3

P r i t u m p e d d i n g n e p h t o m y

of incision with a large number of glomerular tufts and tubules well preserved it seemed as though recovery might have been complete. According to Rehn postoperative hemorrhage occurs in from 10 to 12 per cent of cases.

## CONCLUSIONS

1. Nephrotomy in dogs with interrupted Cushing sutures in the capsule is apparently a safe procedure.

2. Cessation of bleeding is brought about by the production of a physiological clot.

## EXPERIMENTAL OBSERVATIONS

In the records in the literature covering thirty three cases of rupture of the oesophagus there appeared to be a question of how many of the histological and anatomical changes were due to pre existing disease, and how many to postmortem softening and degeneration. It therefore occurred to us to study the effect of experimental lesions of the healthy oesophagus in the living animal and observe what degree of change occurred postmortem. We made a copper olive of such size that it would just pass the larynx of a small dog. This olive was cut half way through with a saw in such a way as to make a sloping slot the distal apex of which emerged at the widest part of the olive. A piano wire was fastened into the small end of the olive to provide control of its position in the oesophagus. A Maissoneuve urethrotome was then inserted in the slot where its cutting surfaces were concealed leaving the handle parallel with the wire of the olive. The animal being anesthetized the apparatus was passed down the oesophagus in this position and when the correct location had been reached the olive was held stationary and the knife pushed onward causing it to emerge from the apex of the slot and perforate the oesophagus. In this position the apparatus was then withdrawn for a distance of 1 inch thus producing an incision 1 inch in length through the oesophageal wall on the right side. The knife was then withdrawn within the olive and the whole apparatus removed with out causing further injury to the mucous membrane.

Upon recovering from the anæsthetic the animal was noticed to lurch on the right fore leg and to jerk its head around to the right side. It was much less active than before the operation and refused all food. Shortly after recovering from the anæsthetic it was given morphine in order to induce vomiting. The vomitus consisted of food particles mucus and streaks of blood. It did not vomit again. After 23 hours the animal was chloroformed and a postmortem was performed at once.

The autopsy showed no evidence of emphysema. Upon removal of the sternum it was at once seen that numerous fine fibrinous

adhesions traversed the anterior mediastinum. The right pleural cavity was also crossed by numerous adhesions of a similar character. In the interstices between these adhesions and filling the right pleural sac there was a large quantity of thin blood stained fluid. This fluid was removed and measured 1.54 cubic centimeters in volume. It contained numerous Gram positive cocci and large Gram positive bacilli. The right pleura was intensely injected and inflamed and covered with a fine layer of fibrin.

Following the same method, a second animal was used and a lesion of the oesophagus produced about 1 inch in length on the right side 1.5 inches above the diaphragm. The animal refused to move about and lay in a cramped curled up position wedged into a corner of the kennel. A frequent catch in the breath was observed. He became acutely ill and died 20 hours after operation.

An autopsy was performed and revealed exactly the same conditions as were found in the previous animal. The left pleural cavity and lung were quite normal in appearance. There was again no evidence of emphysema. The right pleural cavity was filled with a sanguineous fluid, and the anterior mediastinum and pleural cavity contained many recently formed adhesions. The right lung was collapsed against the posterior thoracic wall. A linear incision 1 inch in length passed through the oesophagus about 1.5 inches above the diaphragm on the right side. There was no blood in the stomach. Sections through the lesion again showed no indication of any inflammatory reaction.

If a conclusion may be drawn from only two experiments we may say in the first place that postmortem alterations are not responsible for the gross and microscopic changes observed in human cases. In the second place it would appear probable that spontaneous rupture of the oesophagus is preceded by some inflammatory lesion which weakens the oesophageal wall for in our experimental animals the inflammatory changes which are so characteristic of the human cases were completely absent. The right lung was of much smaller volume than the left and was compressed against the pos-

developed some form of gastric trouble characterized by occasional attacks of belching of gas with distress after meals. This condition was thought to have been due to peptic ulcer. For about a year before his death the patient had been in the habit of drinking an unusual amount of water getting up three or four times each night for a drink. He had not consulted a physician about this. On October 15 he ate his lunch as usual and about 3 p.m. went out goose shooting. He walked about on the prairie until 7 p.m. when he called at a farm house and was given a drink of cherry wine which was the only nourishment taken since lunch. He then started back toward home and arrived there about 10 p.m. During the return journey he experienced slight abdominal discomfort and shortly after arriving home he vomited. During the act of vomiting he was seized with a most intense pain in the upper abdomen just beneath the lower end of the sternum. He exclaimed my heart has burst and declared he felt something tear within him. Great pain was immediately experienced and a physician was summoned at once. The patient did not toss about but lay absolutely still and begged not to be moved in any way. During the next hour and a half he received by hypodermic injection over 1 grain of morphine without any material relief from the excruciating pain. The pulse was 86 and the respirations were observed to be short, catchy and rapid but were not counted. The systolic blood pressure was 130 the diastolic 75. His color was good. There was no rigidity or tenderness of the abdomen. The pain continued intense throughout the night and was so agonizing that it was impossible to remove the patient's clothing. Early in the morning he was again given morphine and later was brought to hospital. When he was admitted to hospital pain was the principal symptom. The pulse was now 140 the respirations 60. The abdomen was a little distended but not rigid except immediately over the diaphragm. The lower abdominal wall was quite soft. He had not vomited again. The breath sounds over the anterior and lateral surfaces of the left side of the chest were suppressed. The heart did not appear to be abnormal or displaced. The leucocyte count was 9,200. The urinalysis showed 1.2 per cent sugar, a faint trace of albumin, a few pus cells and a few granular casts. The blood sugar was 53 per cent, creatinine 4.5 milligrams per 100 cubic centimeters.

These findings showed the presence of a diabetic condition for which he had never consulted a physician nor had any treatment. The patient was so ill that operation was deemed inadvisable. He grew steadily worse and in spite of large doses of morphine the pain was never controlled. The pain at one time radiated round to the left side of the chest and the left shoulder and down the left arm. He died at 8 p.m. a little less than 20 hours after vomiting ushered in the attack.

**Autopsy findings.** At the autopsy which was performed 12 hours after death the following points

were noticed. There was no emphysema of the skin. In the abdominal cavity there was no free fluid nor sign of any inflammatory condition. The abdominal organs showed no evidence of disease. The right pleural cavity, the right lung and the heart showed no abnormality. The left pleural cavity was practically filled with a dark reddish brown fluid containing numerous particles of meat and other solid foods. The lung on the left side was completely collapsed and when the chest was first incised air rushed in showing a negative pressure. A perforation 1 inch in diameter was found about 1 inch above the diaphragm and on the left side of the esophagus leading directly into the pleural cavity. The stomach contained a considerable amount of dark reddish brown fluid and it was easily possible to force this fluid through the rupture of the esophagus into the left pleural cavity.

Sections were taken through the lesion of the esophagus the esophagus just above the lesion through the cardiac orifice of the stomach and through the fundus of the stomach. Upon examination the section from the upper esophagus showed abundant cellular exudate between the muscle bundles. This was much more pronounced in the outer than in the inner layers. These inflammatory cells were mostly mononuclear in type but there were also numerous polymorphonuclears. The epithelium appeared normal. In sections stained by Gram's method enormous numbers of bacteria could be seen in the outer layers of the esophageal wall a few in the inner layers and none at all on the surface of the mucous membrane. Most of these bacteria were large Gram positive bacilli with a few Gram positive diplococci. Section through the lesion showed such extensive destruction and disintegration of the wall of the esophagus that it was not possible to be certain which was the inner and which the outer coat. All trace of the mucous membrane had disappeared. In the middle of the muscular coat there was a large collection of inflammatory cells mostly polymorphonuclears with a smaller number of mononuclears. In sections stained with Gram there was again the same intense bacterial invasion. In addition there were considerable numbers of yeast like bodies some in the process of budding.

Section through the cardiac orifice resembled the histological picture seen at the site of the rupture. The mucosa had entirely disappeared and the muscle tissue was disintegrated and infiltrated with inflammatory cells and bacteria. Section through the fundus of the stomach showed the serous muscular and submucous coats to be quite normal with no trace of inflammation. The mucous membrane showed a certain amount of degenerative changes as evidenced by desquamation of the surface epithelium and loosening of the cells lining the glands. No evidence of inflammation could be found in the mucosa. The difference between this section and those taken from the cardia and the esophagus was most striking.

BACTERIOLOGY OF THE THYROID GLAND IN GOITER<sup>1</sup>

By ANTONIO CANTERO B.A. ROCHESTER MINNESOTA  
Special Stud. at Bacteriology Th. M. J. Foundation

**T**ISSUE bacteriology of the thyroid gland appears to be a new method of investigating the etiology of goiter. Since the work of Farrant and McCarrison there has been no doubt but that a 'contagium vivum' plays an important part in diseases of the thyroid gland. These investigators were the first to advance definite evidence of a specific bacterial agent as the cause of thyroid hyperplasia. The constant finding of a mutant colon bacillus in feces of goitrous patients and the results of animal experimentation led these investigators to believe that prolonged ingestion of the bacillus from contaminated waters causes endemic goiter because its toxin affects the thyroid gland. Galli Valerio has shown that goiters can be produced in rats by the injection of bacillus pseudopestis mutium isolated from the waters of the Jura Mountains. The bacillus was found to have a specific local effect on the thyroid tissue bringing about tumefaction and abscess formation.

Gilbride in 1911 made a bacteriological study of 14 cases of goiter. He isolated micrococcus tetragenus from the thyroid gland in one case of exophthalmic goiter and streptococcus vermiciformis of Sternberg in one case of cystic goiter. In none of the other 12 cases was a growth obtained.

Rosenow, in 1914 isolated a diphtheroid non hemolyzing streptococcus from the thyroid gland in 25 of 32 cases of goiter (mostly exophthalmic goiter) in man and in 8 of 12 dogs having goiter. These organisms when injected repeatedly into dogs over periods ranging from 20 to 70 days produced goiter loss in weight and diarrhea. In one dog softening pulsation and bruit of the thyroid associated with marked tachycardia and tremor also developed. Microscopically there were noted vacuolization and irregular staining of the colloid colloid within vessels areas of necrosis and a variable degree of hyperplasia.

Clinical evidence of an association between infection and disease of the thyroid has not been wanting. Thus, Vincent called attention

to the frequent enlargement of the thyroid gland in acute articular rheumatism. Albertin Bech and Acciote also attributed certain lesions of the thyroid gland to acute rheumatism. Halsted emphasized the importance of infection as the cause of hyperplasia of the thyroid. Beebe found that 40 per cent of the patients with hyperthyroidism gave a history of repeated attacks of acute tonsillitis. Nor regard found localized infections usually in tonsils in a group of 35 cases of goiter. C. H. Mayo also emphasized the relationship between focal infection and hyperactivity of the thyroid gland. Billings reported cases in which goiter disappeared after tonsillectomy.

It occurred to me that the difference in the results obtained might be explained by differences in the technique employed. Gilbride planted pieces of tissue in various mediums which did not afford a gradient of oxygen tension whereas Rosenow inoculated emulsion of the tissue in mediums that afforded not only aerobic and anaerobic conditions but a gradient of oxygen tension.

I used the method of Rosenow in all cases and also the methods used by Gilbride as controls in selected cases.

## TECHNIQUE

Cultures from the tissues were prepared under sterile conditions. Immediately after excision of the gland by the surgeon the specimen with the least handling possible was covered with sterile gauze or a towel and taken to the laboratory. By means of a hot blade a large surface of the gland was seared. With a sterile Pasteur pipette the seared surface was punctured fluid for culture was drawn and then a portion about 1 cubic centimeter was emulsified. With sterile instruments the tissue was removed by cutting into the seared surface. The excised tissue was passed rapidly through a flame then washed three times in normal sodium chloride solution placed in a mortar in a sterile air chamber and emulsified with normal sodium chloride solution and



terior thoracic wall by the large amount of fluid. The left thoracic cavity showed no adhesions the left pleura appeared normal the lung was not collapsed and no exudate was present. The œsophagus was found perforated by a linear incision about 1 inch in length on the right side 2 inches above the diaphragm. There was no blood in the stomach and nothing of interest in other organs.

For microscopic examination sections were made of the œsophagus at the site of the lesion above the lesion, and below the lesion from specimens taken immediately after death and repeated from specimens taken after 24 hours of postmortem decomposition *in situ* in the cadaver. Examination of a section through the lesion taken immediately at death showed no indication of inflammatory reaction. The stratified epithelium was intact and the underlying tissue showed neither congestion nor an inflammatory exudate. Sections of the œsophagus taken from above and below the lesion at death showed the same conditions as those found at the lesion. Of the sections from material taken 24 hours after death those below and through the lesion showed no change in the histological picture that above the lesion showed evidence of degeneration such as pyknosis of the nuclei and disintegration of the cytoplasm.

#### DISCUSSION BY T. H. WILLIAMS

There has been considerable speculation as to the cause of the rapidly fatal termination in cases of spontaneous rupture of the œsophagus as compared with the protracted and frequently non fatal course of ulceration into the œsophagus of some tuberculous or other chronic inflammatory nature. The cases so far reported have usually shown at autopsy a large amount of fluid in the pleural cavity which in some cases contained food particles and has been explained as due to the passage of gastric contents through the lesion of the œsophagus into the pleural cavity. This explanation hardly appears to be an adequate one. In both our experimental cases the pleural cavity was filled with fluid but this was alkaline, contained no gastric contents, was of the nature of an exudate and teemed with hœtina, while the stomach contained

no similar fluid but on the contrary a dried curdy mass. The rapid throwing out of this exudate together with the extreme degree of pleural inflammatory reaction seen within 24 hours in these two cases seems to indicate that death is due to a sudden attack by virulent organisms within an undefended closed and toxin absorbent cavity in which no immunity has been raised. In those cases of slow ulceration into the œsophagus which have been reported as terminating favorably this is prevented by the formation of a protecting layer of granulation tissue.

The presence of this infected fluid in the pleural cavity would suggest that surgical measures are indicated wherever a diagnosis of spontaneous rupture of the œsophagus can be established with any degree of certainty. Pleural puncture and aspiration of the exudate indicated to verify a suspected diagnosis of rupture followed by efficient drainage of the infected cavity might result favorably in those cases in which a simple linear tear of the œsophagus has occurred.

#### CONCLUSIONS

1 Rupture of the œsophagus is a rapidly fatal condition usually resulting in death in the course of 24 hours.

2 The advanced histological changes in the edges of the lesion found both in our own case and in those described in the literature cannot be explained merely as the result of postmortem digestion. Our experimental work has shown that when rupture of the œsophagus is produced in a healthy animal, these changes do not occur.

3 It appears probable that spontaneous rupture is preceded by some inflammatory process which weakens the œsophageal wall.

4 A possible method of surgical treatment for an otherwise hopeless condition is suggested.

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streptococcus, and in some cases showed a distinct capsule. It produced small pinpoint, slightly elevated colonies on blood agar surrounded by a green zone. It was also highly sensitive to oxygen in the primary culture.

The animal experiments are too few to be of much value but since the results corroborate in important respects those obtained by Rosenow in this and other fields a brief summary of them is given.

Freshly isolated cultures of the streptococcus in glucose brain broth from 4 cases were injected intravenously into rabbits. One additional strain was injected on isolation after a number of transfers on artificial mediums and one strain after prolonged cultivation and one animal passage. Six rabbits were injected with from 2 to 5 cubic centimeters each of the freshly isolated strains. Of these 5 died from the effects of the injection. A variable degree of hyperemia and swelling of one or both lobes of the thyroid gland was found in all and was marked in 2. The streptococcus was recovered from emulsions of the thyroid gland in all and from the blood in 4. No gross lesions of the viscera developed. Six rabbits were injected in a similar manner and in like dosage with the streptococci after several subcultures. Of these all remained well and were chloroformed in from 1 to 2 weeks. Only 1 showed changes in the thyroid gland and none showed lesions in other organs. The streptococcus was isolated from emulsions of the thyroid in 4 and from the blood in 3.

#### COMMENT

The predominance of the streptococcal flora seems to be of some significance since enlargement of the thyroid gland and true thyroiditis are so commonly noted in diseases that have been shown to be due to streptococci or are associated with localized streptococcal infections.

The discrepancy between the results obtained by Gilbride and Rosenow is explicable on the basis of differences in their technique

From the results of this bacteriological study and experimentation, it would seem that localization of certain organisms, especially those belonging to the streptococcal group in the thyroid gland may be an important factor in the pathogenesis of goiter.

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sand. The pipetted fluid and emulsion were inoculated into the following mediums: glucose brain broth, glucose broth, meat infusion and soft glucose brain agar (0.3 per cent) in tall columns (10 to 12 centimeters) and plain broth in low columns (3 to 5 centimeters). Dextrose broth in bottles containing 150 cubic centimeters was inoculated with the residue of the emulsified tissue. Anaerobic cultures were made on blood agar slants by the pyrogallic acid method. Aerobic cultures on blood agar plates of the pipetted material and emulsion were also made in some instances but this was not done as a routine because the organisms which were being sought required a certain gradient of oxygen tension for their growth.

The glucose brain broth medium was prepared from Difco dehydrated broth to which 0.2 per cent glucose and about the equivalent of 2 centimeters of calf brain with several small pieces of marble were added before sterilization. The glucose brain agar was prepared from meat infusion to which 0.3 per cent agar (just sufficient to jellyify) and calf brain were added. The glucose (0.2 per cent) broth, plain broth and agar to which 5 per cent horse blood was added before pouring were made from extract of beef and peptone (Difco). All mediums were adjusted to hydrogen ion concentration 6.8 to 7.2, sterilized at 20 pounds pressure for 20 minutes and clarified by means of a continuous feed centrifuge. In inoculating these mediums I purposely varied the amount of inoculum in order to make the range of oxygen tension and other conditions as wide as possible. The cultures were incubated at 37 degrees C. for from 1 to 7 days and were examined daily.

#### RESULTS OF CULTURES

Cultures were made of the thyroid tissue from 50 goiters. Most of them were colloid or adenomatous goiters that had existed for a long time. In only 3 cases did the cultures fail to show growth. Positive results were obtained in all of the rest. In accordance with Rosenow's previous findings the predominant flora was found to be of streptococcal morphology. Organisms belonging to this group were isolated in 31 cases. Pneumococci

were present in 5 additional cases. *Welch's bacillus* in 2, a diphtheroid *bacillus bacillus pyocyaneus*, and *micrococcus tetragenus* in 1 case each and *staphylococci* in 7 cases. Tall columns of glucose brain broth and glucose brain agar mediums affording a gradient of oxygen tension yielded the highest percentages of positive results: the former yielding growth in 25, the latter in 28 of 34 cases in which the results were tabulated according to mediums. Glucose broth in tall columns gave the next best results yielding growth in 14. Plain broth in low columns showed growth in only 4 cases, meat infusion in 5, aerobic blood agar in 4, and anaerobic blood agar slants in 8. The streptococcal growth in broth was often seen to begin in the bottom of the tall tubes and extended to the top in from 12 to 24 hours. The colonies of streptococcus in the shake cultures of the soft glucose brain agar were usually few and were always situated in the lower levels of the medium. Organisms which did not grow on blood agar on direct plating of the emulsions nor in the aerobic part of the shake cultures of the soft agar would do so on the second or third subcultures. In a few cases this was impossible and the organisms were strictly anaerobic.

Successful cultures of the streptococci on blood agar plates revealed both the green producing and hemolyzing varieties. The colonies of the viridans instead of being pinpoint in size, dry and elevated were fairly large, shiny and only slightly elevated but were surrounded by a typical green halo. The zone surrounding the colonies of the hemolyzing types was usually hazy and narrow in sharp contrast to that of the typical hemolytic streptococcus.

The results from planting pieces of tissue according to the method of Gilbride in low columns of bouillon containing calcium chloride and in salt solution were usually negative and the streptococcus was not obtained.

Morphologically the viridans and hemolytic streptococci appeared much alike and produced short chains of 3, 4, or 5 gram staining cocci of uniform size. Only in a few cases were long chains of 10 to 12 cocci encountered. The diplococcus isolated in 5 cases was gram positive about the same size as the

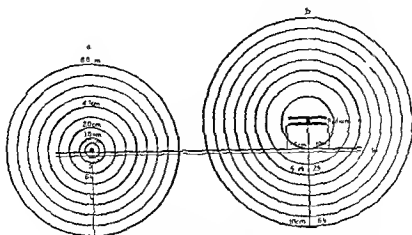


Fig 1 Effect of distance on radium dosage (inverse square law)

hampered by considerations of supply and cost methods might be devised to solve the physical problems. We might even learn how to neutralize the danger of handling such quantities of radium. For the time being however we must adapt our methods to the facilities available and to the physical endurance of our patients.

From the foregoing it can be easily understood why the maximal usefulness of radium is limited to a short radius. The chief indication of radium is therefore for lesions or tumors of limited size on or near the surface of the body or accessible from the outside the extent of which can be determined with a fair degree of accuracy. It is most useful when it can be introduced directly into the substance of the lesion in such a manner as to deliver to every part an adequate and fairly uniform dose. Sometimes the radium can be concentrated in one large unit but generally the implantation method is more effective, many units each containing a small quantity of radium element or emanation being introduced at regular intervals throughout the tumor. If the lesion is large or if as in many malignant growths its shape is irregular and its extent ill-defined, and especially if it is below the surface radium is not the agent of choice. Under such conditions X rays are more efficacious although in many cases both agents can be combined advantageously. For example in carcinoma of the uterine cervix the indica-

tions for radium are ideal because through the cervical canal the radio active unit or units can be placed in the very center of the diseased area. It can thus exert full action in every direction with great benefit in many cases yet on account of the inexorable influence of the law of the inverse square the maximal effect is limited to a radius of between 10 and 20 centimeters. If, therefore the zone of malignant degeneration extends farther and its outlying elements do not receive sufficient radiation to bring them under control, an attempt is made to compensate for this deficiency by giving X ray treatment from without.

When, because of metastasis to axillary and supraclavicular nodes carcinoma of the breast becomes a problem for the radiologist how should it be treated? To attack such widespread dissemination with radium would require a quantity seldom available because in order to be effective, it must be used at a distance. The great cost of such treatment would be justified only by a higher degree of effectiveness than we are warranted to expect from past experience. Such cases are best dealt with by means of X rays but it is sometimes possible to increase the effect and shorten the period of treatment by also using radium units buried throughout the primary tumor.

Radiotherapy before and after surgical amputation of an operable carcinomatous breast should be carried out by means of

COMMON MISCONCEPTIONS IN RADIOTHERAPY<sup>1</sup>

BY ARTHUR U. DESJARDINS, M.D., ROCHESTER, MINNESOTA

Sent on Radium and Röntgen Ray Therapy May Clinic

**A**MONG surgeons and internists there is some confusion concerning the relative advantages of radium and X rays in the treatment of many diseases. We often read articles by physicians who advocate X rays in dealing with a certain condition and other articles favoring radium just as strongly in the same disease. Under such circumstances it is but natural that an impression should arise that the two agents conflict when really they do not.

As soon as the therapeutic value of radium became recognized certain members of the profession hastened to make use of this valuable substance. Some of them were radiologists while others were medical or surgical practitioners without special training in radiology. Some were equipped and trained to use both agents; some to use one agent or the other while others possessing one or both agents had no training. What would be more natural therefore than that the possessor of such an expensive substance as radium should employ it and advocate its use as much as possible or that one with facilities only for X ray treatment should speak or write of it exclusively? Moreover there are diseases or phases of the same disease in which either agent may be used to produce effects more or less similar in character and degree. Thus the sources of confusion and misunderstanding are at once made apparent. By their nature and the circumstances surrounding their production both agents possess certain advantages and disadvantages.

Radium is available in measurable quantities of radio active substance either in the form of a salt (radium element in metal capsules or needles) or in that of a gas (radium emanation in glass capillaries). Its supply, however is limited and its cost almost prohibitive. Now radium in whatever form is like all other radiations subject to the inverse square law by virtue of which the intensity of its rays diminishes according

to the square of the distance. Therefore if we apply any unit of radium to the surface of the body and leave it in position long enough to deliver the maximal dose that the skin will tolerate without damage calling such a dose 100 per cent, the percentage of this dose reaching certain depths beneath the surface will be as shown in Figure 1.

In Figure 1 may be seen a double horizontal line representing the skin, and two sets of circles at different distances from the center of the diagram. In each case the center consists of a unit of radium. In A the radium unit is in immediate contact with the skin. If then a dose is given to the limit of skin tolerance and if such a dose at a distance of 0.5 centimeter from the skin is considered as 100 per cent the dose at 1.0 centimeter will be only 25 per cent and at 2 centimeters only 6.25 per cent of the surface dose. In B the distance between the unit of radium and the surface of the skin has been increased to 2.5 centimeters. Under these conditions the time necessary to deliver a full dose to the skin is much longer. Moreover the effective dose 2.5 centimeters below the surface (5 centimeters from the radium unit) although much greater than when the radium unit is in immediate contact with the skin is only 25 per cent of the full surface dose.

The percentage of the 100 per cent dose reaching different levels below the surface can be altered by increasing or decreasing the amount of filtration through which the rays have to pass and by increasing the distance between the radium unit and the surface but such increase involves a longer time of exposure to deliver a 100 per cent dose to the surface. Indeed to attempt any significant increase of the depth dose percentages by increased filtration and distance requires such an increase in the time of exposure as to be wholly impracticable. The only possible way to overcome this obstacle would be to use a larger quantity of radium but its cost makes this prohibitive. Were we not

stimulating dose of  $\lambda$  rays or of radium, they would be unable to do so. How then, has such a belief become so widespread and whence has it arisen? Surely there must be some fire to account for the smoke.

The action of radium and  $\lambda$  rays on plant and animal life has been the subject of many experiments. When we scan the printed records we find for instance that when blood is irradiated there occurs within 24 to 48 hours a slight leucocytosis followed by a pronounced leucopenia lasting many days. Arntzen and Krebs have recently shown that when germinating peas are subjected to very small doses of  $\lambda$  rays their growth during the first 24 or 48 hours is slightly more rapid than that of controls but that after this their rate of growth diminishes steadily. Similar results have been reported by almost all experimenters the only variation being that with larger doses the transient increase in rate of growth does not take place. In nearly all such studies it has been found impossible to prolong this transient phase of apparent stimulation which varies somewhat according to the sensitiveness of the individual plant or animal. Whether experimenting with peas and other plants or with amoebæ, frog eggs or other animal forms the mature products have been always either normal or deficient in different respects (generally slow growth and failure to reach full development) no one has ever been able to produce in this manner larger specimens of any variety of plant or animal or to cause them to mature in less time than the unexposed controls. Moreover, the results in growing plants and in all forms of animal life are wholly in accord with our experience with radiotherapy in human beings. No one has ever brought forth the slightest evidence in favor of the theory of stimulation in the sense of continued acceleration of cell life. Certainly in my experience there has never been anything which could even remotely suggest such a possibility.

Since early in 1896 the skin of thousands of human beings has been exposed to every conceivable dose of  $\lambda$  rays. Were stimulation by such means possible surely by this time there should have appeared a new race

of men with thick skins and long body hair, but, so far as I am aware, the human skin is approximately the same now as it was in 1895. Radium and  $\lambda$  rays may cause the hair to fall out temporarily or permanently, but, unfortunately, cannot increase the growth of hair. The activity of the sweat glands also can be diminished by exposure to radiation, but no one has thus been able to make them secrete more freely. All the changes resulting from the action of radium and  $\lambda$  rays on tissue cells are degenerative in character. Repeated over exposure may, it is true, cause such degeneration to become malignant. This has occurred in radiologists who have been careless of themselves and a few instances have occurred in patients subjected to the rays frequently and over a long period of time. This is not stimulation in the sense of increased activity, but aberrant function due to chronic irritation. In considering stimulation with reference to the effect of radiation on tumors, it has never been shown that the rate of growth of a tumor can be accelerated in this way.

#### DIRECT OR INDIRECT BIOLOGICAL EFFECTS

The power of an idea is a marvelous thing. Even if the idea is wholly or partially false it is often astonishing how far it will travel before the truth can overtake and either destroy or correct it. When the true explanation of any scientific phenomenon is finally reached its mechanism is generally found to be much simpler than that of most of the hypotheses previously held concerning it. The simple, obvious thing is generally the last to be thought of. Too often we forget that a hypothesis is nothing more than a plausible, but fanciful explanation of certain observable phenomena based partly on certain known facts partly on circumstantial evidence and partly on the law of probability. Too often a quarter or a half truth is seized on and, by the generous admixture of an artificial mortar made up largely of wisps of imagination is erected into a figure supposedly representing the truth.

An example of this is seen in the present attitude of many radiologists toward the mechanism of the biological effects produced

X rays, because it is essential to irradiate a large territory as uniformly as possible. This would not be feasible with radium unless the quantity was sufficient to enable its use at a distance like an X ray tube. The same principle applies in the treatment of recurrent or metastatic deposits because it is naturally and justly assumed that the entire lymphatic drainage is affected.

At short range radium has a more intense action than X rays, and this advantage is sometimes most useful. For example when repeated X ray treatment no longer influences superficial carcinomatous nodules radium may still produce the desired effect. Seldom is the reverse true. This advantage of radium can often be utilized in the treatment of many diseases or of different phases of the same disease. Thus in a superficial recurrence of carcinoma or other forms of malignancy radium may often be employed with at least temporary success after the effectiveness of X rays has become neutralized by the increasing tolerance of the lesions. But since radium itself can seldom arrest the activity of malignant cells permanently, it should be reserved until the power of X rays has been completely expended. Control of malignant deposits can thus be maintained for a longer period. This does not apply to solitary foci which sometimes can be permanently overwhelmed by a massive attack with radium.

In Hodgkin's disease and in lymphosarcoma the lymph nodes throughout the body may be diseased. Regardless of the apparent limits it is best, at the outset to treat all the main groups of lymph nodes, whether enlarged or not including those in the mediastinum and along the dorsolumbar portion of the spine. Such treatment is generally most successful with X rays. In certain cases however the enlargement of the nodes in one region may be so great as to produce pressure symptoms which should be relieved as quickly as possible when the greater superficial action of radium can often be brought to bear with good effect but experience has shown that too rapid reduction in the size of such nodes is not always an advantage to the patient. Clinical judgment in

estimating the stage of the disease is an important factor in deciding how intense and how concentrated the treatment should be.

Tumors or lesions deep within the trunk whether thoracic or abdominal are more effectively treated with X rays than with radium and this in spite of the great radio-sensitiveness of certain forms of tumors such as the malignant embryoma or seminoma. This variety of tumor is so sensitive to radiation that even its secondary manifestations yield readily to moderate doses of either X rays or radium. Although striking regression often follows the application of radium to the surface of the abdomen X ray treatment is preferable, because the full extent of the malignant dissemination cannot be ascertained and it is essential to irradiate, not only the part of the tumor which can be felt through the abdominal wall but also the part in the surrounding tissues.

The choice between radium and X rays in dealing with benign lesions rests on their extent volume and depth. Small keloids are best treated with radium while X rays are preferable for large keloids. When uterine fibromyomata adjoin the mucosal surface radium inserted into the cavity of the organ is generally sufficient. X rays are more beneficial when the tumors are subperitoneal. But in most cases both agents should be combined because it is so seldom possible to determine the location of the tumors accurately.

#### STIMULATION

The idea that radium and X rays can stimulate cells is often expressed or implied by physicians. They either believe that such stimulation is actually produced or that it may follow treatment of a malignant tumor and increase its rate of growth. I recently heard two radiologists on the witness stand swear that the action of these agents may be stimulating or destructive. I am quite certain that if these two radiologists had been asked whether they had ever seen evidences of stimulation resulting from radium or X ray treatment they would have promptly answered 'no'. We sometimes hear radiologists speak of a 'stimulating dose', yet if they were to specify the amount of a

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AN EXPERIMENTAL STUDY OF RUPTURE OF THE UTERUS<sup>1</sup>

By JULIUS E LACKNER MD FACS CHICAGO

A VAST amount of work on rupture of the uterus has been published during the past 50 years. A careful review of the literature reveals only a clinical study of the many etiological factors involved the pathology the mechanism symptoms and especially the treatment. The object of this paper is to present the findings of a series of experiments on rupture of the uterus in the lower animals to determine the more exact etiological factors in the causation of this condition. It is obvious that human material is not available. The uteri of the lower animals are bicornuate yet the histological structure and physiology are apparently analogous.

While these experiments are not completed we feel that the data obtained is of sufficient interest to present in a preliminary report. This work has been in progress during the past year in association with Dr S S Schochet.

The first series of experiments were conducted to determine if the type of incision in the uterus was a predisposing cause of rupture in a subsequent pregnancy.

The second series of experiments were designed to determine if the type of suture material played an etiological role in rupture of the uterus.

Only these two phases of rupture of the uterus are presented. The many other factors which we are working on will be discussed in a subsequent series of papers.

Thirty two female goats were used in these experiments. We have found that the uterus of this animal is suitable for operative procedures and pressure determinations in this

work. In order to understand more clearly the *modus operandi* of these experiments a brief description of the apparatus and materials is here given.

The apparatus (Fig 1) consists of a pressure tank connected to a one arm calibrated mercurial manometer by means of a calibrated Y shaped connecting tube the arm of which is connected with the uterus of the goat. A spring gauge is also attached to this manometer to estimate roughly the pressure levels in the mercurial arm. A second tube connects the mercurial manometer with a small glass bottle so as to control the various gas volumes in order that the recording pointer in the second calibrated U shaped mercurial manometer will not record higher curves than the size of the smoked drum of the kymograph.

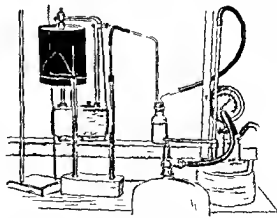


Fig 1 The apparatus

The apparatus which appears of very simple construction required several weeks for completion as we were not able at first to surmount the many difficulties encountered.

Read before the Chicago Gynecological Society, June 9, 1925. From the Research Laboratories of the Morris H. L. Memorial Institute for Medical Research, Michael Reese Hospital, and the Laboratory of Pathology, St. Bernard's Hotel, Chicago. For discussion see p. 49.



by radiation. When living tissues are subjected to X rays or to radium, certain changes follow and in a definite sequence. If for instance the skin is treated the exposure will according to the dose, be followed by epilation by erythema and atrophy, or by ulceration. No one would venture to attribute such effects to anything but reaction to the rays on the part of the tissues thus exposed. Yet as soon as we approach the question of malignancy the idea is advanced that the biological effect of the rays is caused by the elaboration of protective substances leading to immunity. And this idea once enounced is copied and repeated until the utmost confusion reigns whenever the subject is brought up.

That the body attempts in various ways to neutralize or to limit the activity of malignant cells is undeniable. Evidence indicates that the blood and the tissue juices possess a definitely lytic power against tumor cells just as they do against bacteria. There is also substantial evidence that local defensive measures are instituted but these are subordinate to and dependent on the general defense mechanism. Among the local defense measures are (1) differentiation of the neoplastic cells (2) lymphocytic infiltration (3) byalinization and (4) fibrosis. Macarty has shown that the malignancy of a tumor depends on the proportional strength of these factors. Murphy and his co-workers have demonstrated that under certain conditions exposure of a tumor to X rays tends to intensify the lymphocytic factor of defense.

Cases are occasionally seen in which regression of a malignant deposit in one part of the body after irradiation is accompanied by similar changes in an untreated lesion in a distant region. Although such instances are not common that they occur at all shows that with the destruction of one element of a malignant process there may be added to the blood or lymph something which may increase the natural power of resistance. Unfortunately experimental attempts to produce such a desirable result have met with but little success. Certainly there is no proof that the systemic defense against can-

cer can be increased by radiation. But admitting that such factors exist and play a part in the pathological physiology of malignant tumors we cannot find in them a satisfactory explanation of the sequence of changes that occur in a tumor after treatment by radium or X rays. Indeed most of our positive information points to the conclusion that the cellular changes brought about by radiation in the case of malignant tumors are of the same order as those produced in normal cells subject of course to the modifications imposed by differences in cell metabolism peculiar to the type of neoplastic process. Therefore how can we write and speak of their biological effects as being due primarily to an immunity reaction?

On the contrary a mass of evidence exists tending to show that the major factor in the effect of X rays or radium rays on cancer cells is a direct one. Mention has been made of the action of such rays on normal skin it is impossible to see how such effects can be considered in any other way than as direct effects.

In the experiments of Martin and Rogers and of Warren and Whipple in which destruction of the intestinal mucosa followed X ray exposure under certain conditions how can we interpret such results otherwise than as a direct effect? If this is true of normal tissues what basis have we for believing that diseased tissues behave differently? When proliferated connective tissue is found to have replaced masses of cells characteristic of some form of malignancy why should we consider the proliferation as due to indirect stimulation of connective tissue by the rays when pathology teaches us that such replacement is a universal phenomenon following degenerative processes? Why invoke a mysterious intangible mechanism for which there is no adequate basis when clinical and experimental data support the more simple view that radiation acts directly on the malignant cells tending to destroy them or to interfere with their metabolism and that their disintegration and subsequent replacement by connective tissue follows one of the main laws of general pathology?

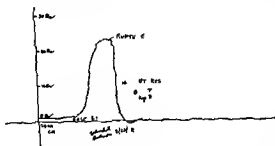


Fig 9 Kymographic tracing of uterus operated upon

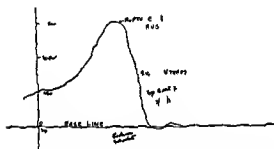


Fig 10 Kymographic tracing of uterus operated upon

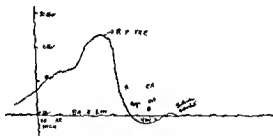


Fig 11 Kymographic tracing of uterus operated upon

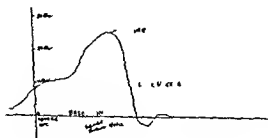


Fig 12 Kymographic tracing of uterus operated upon

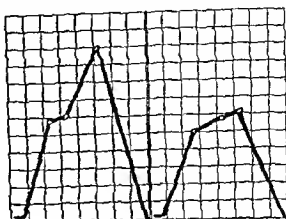


Fig 13 Composite curve of rupture of uterus

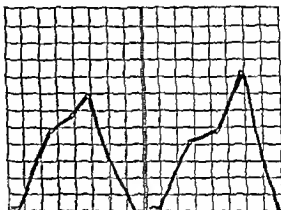


Fig 14 Composite curve of rupture of uterus



Fig 15 Composite curve of rupture of uterus



Fig 2 Kymographic tracing of uteri not operated upon

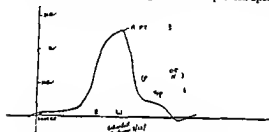


Fig 3 Kymographic tracing of uteri not operated upon

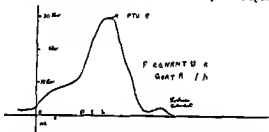


Fig 4 Kymographic tracing of uteri not operated upon

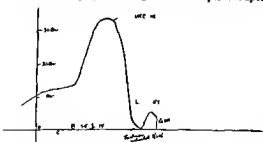


Fig 5 Kymographic tracing of uteri not operated upon

It is obvious that it is necessary to have this arrangement of apparatus to trace successfully pressures varying from zero to 35 pounds per square inch. The mathematical calculations and the hydraulic and gas laws involved in obtaining the correct pressure will be presented by Dr Schochet (see discussion p 149).



Fig 6 Composite curve of pressures required to rupture normal uteri

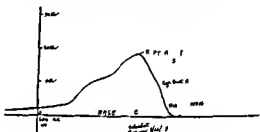


Fig 7 Kymographic tracing of uteri operated upon

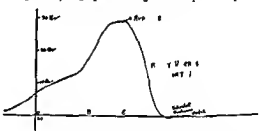


Fig 8 Kymographic tracing of uteri operated upon

The goats were operated upon under strict surgical aseptic conditions. The incisions were sutured with No. 00 plain chromic and iodized catgut and the subsequent pressure readings on these uteri were made from 5 to 6 months after operations.

In order to determine whether the type of incision played an etiological rôle it was necessary to determine the average normal pressure required to rupture the unoperated non gravid uterus. The uteri of 7 goats were tested to determine the amount of pressure per square inch necessary to rupture the uterus. As shown in kymograph tracings the pressures required to rupture a normal uterus

sutured with iodized catgut ruptured at pressures of 21, 24 and 30 pounds. The uteri incised longitudinally, ruptured at pressures of 18, 20 and 35 pounds. The transversely incised uteri which had been sutured with the chromic catgut ruptured at 21, 28 and 30 pounds pressure and the longitudinally incised uteri ruptured at 25, 32, and 35 pounds pressure (Fig. 15).

Figure 16 shows a comparative composite curve of pressures necessary to rupture uteri operated upon and incised transversely. A study of this graph shows comparatively very little difference with one exception. With the chromic catgut the average pressure required to rupture the uterus was 26.3 pounds per square inch. With the iodized catgut the average pressure was 25.3 pounds per square inch. With the plain catgut, the average pressure was 32 pounds per square inch. The higher average pressure obtained with plain catgut is due to the fact that the horn of one uterus required 37 pounds per square inch to rupture. We propose to make a later study of the connective tissue arrangement in the horn of this uterus.

Figure 17 shows a comparative composite curve or graph of pressures required to rupture uteri operated upon and incised longitudinally. The average pressure required with chromic No. 00 catgut was 30.6 pounds per square inch.

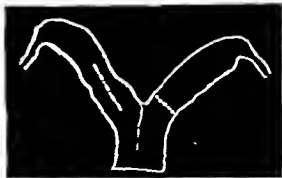


Fig. 19 Diagram to show location of incisions

The average pressure with iodized No. 00 catgut was 26.3 pounds per square inch, and the average pressure with plain No. 00 catgut was 27 pounds per square inch. (Compare with Figure 18 of uteri not operated upon.)

If the pressures of the 6 longitudinally incised uteri with the three different types of catgut are averaged, we have a pressure of 27 pounds per square inch. Likewise if the pressures of the 9 transversely incised uteri with the three different types of catgut are averaged, we have a pressure of 27 pounds per square inch.

#### CONCLUSIONS

The pressure required to rupture the uteri of goats operated upon is not affected by the type of incision or the character of catgut employed.

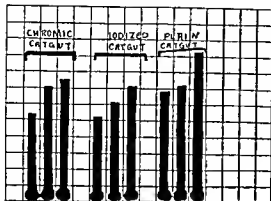


Fig 16 Composite curve of pressures required to rupture uteri

varied from 12 to 32 pounds per square inch (Figures 2, 3, 4 and 5)

However most of the uteri were ruptured by a pressure of more than 22 pounds per square inch

Figure 6 is a composite curve of the pressures required to rupture the normal uterus. This curve was made by using the ordinates of the curves in Figures 2, 3, 4 and 5. The abscissa of the curves were not taken into consideration as this would include the factor of time, and the fracture or segmentation of muscle fibers which will be dealt with in another paper. With the establishment of this average pressure or norm required to rupture the uterus of a non gravid goat not operated upon we then proceeded to determine whether the

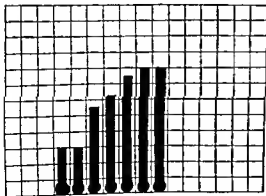


Fig 18 Composite curve of pressures required to rupture uteri not operated upon

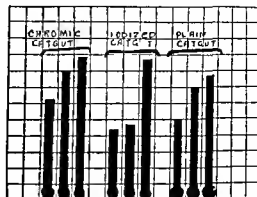


Fig 17 Composite curve of pressures required to rupture uteri

type of incision and the type of catgut played etiological rôles in the rupture of the uterus. Three goats were operated upon under surgical aseptic conditions. One horn of the bicornuate uterus was incised transversely on its anterior median surface through the serosa, muscularis and mucosa and sutured with plain No. 00 catgut. The horn of the opposite side was incised longitudinally through the three coats and sutured with plain No. 00 catgut. The abdomen was closed. Three other goats were operated upon in a similar manner except that iodized No. 00 catgut was used. In the third group of 3 goats similarly treated chromic No. 00 catgut was used. The abdominal incisions of these goats healed by primary intention. We do not include in this group of 9 goats those that had infected abdominal wounds or those dying from postoperative complications.

At the end of 6 months kymographic tracings were made to determine the pressure required to rupture the uteri of these goats that had been operated upon (Figures 7, 8, 9, 10, 11 and 12). These figures show the kymographic tracings of rupture from transversely and longitudinally incised uteri sutured with plain No. 00 catgut. The pressures necessary to rupture the transversely incised uterus in which plain catgut was used (Fig. 13) were 29, 30 and 37 pounds per square inch, 22, 28 and 31 pounds in the longitudinally incised uteri. As seen in the composite ordinate curve of Figure 14 uteri incised transversely and

room laboratory and clinic of nurses and social workers, as well as of the public at large. Teaching is of definite value to the one endeavoring to impart knowledge as well as to the recipient of the effort. Right methods and so greatly that our own society would greatly benefit by conscious effort to discover and practice them. It would seem that most of us fail to question ourselves frequently enough about what we know how available we have our knowledge arranged and how we can best utilize it. Too much of our time is used in trying to make understood by words alone novel and unshown phenomena. How many medical names mystify the student as well as the layman because in their experience there is nothing to which the strange word can be properly attached? Therefore to 'show fully' or demonstrate should come early and before discussion that is it should come before the shaking apart or analytic phase of teaching.

Oral presentation is of great benefit in that it enables emphasis to be placed on the varying value of facts and permits grouping them in new relationships so that old truths are seen in new vistas and acquire additional interest. Oral teaching should not supplant but should supplement and illuminate the printed word. Obstetrical texts exist in abundance valuable for reference and often encyclopedic. Perhaps they are too voluminous for the classroom and too complex to be grasped by the beginner. Quiz compends also abound to reduce the beginner from the status of student to that of parrot. Is there not a need for handbooks or introductions that will broadly outline the topography of this division of medicine correlate its outstanding features give wide horizons and form the framework which the individual may later elaborate from personal experience and study?

Why should we not standardize more of our technical vocabulary dealing with the definite phenomena and facts of obstetrics? Is it not strange that even here in our society it is often difficult to grasp the exact meaning of technical terms because their use is restricted to one or another teaching group? Why should anyone's vanity prevent the co-ordination of terms and definitions that please him with

those used by others for like things? This society might well be a clearing house for this purpose and certainly students would benefit by having an authoritative list of such synonyms as would we ourselves for teaching purposes. When there are several differing sets of terms for such basic facts as the relations in space between mother and fetus of which the average student knows only the set preferred by his teacher it is no wonder that misunderstanding results when he goes out from such instruction.

The graduates of all our schools seem to have learned lists of facts without having discussed their interrelationship or usable value. Perhaps hypotheses are too often taught as if they were established beyond dispute. In the recent examination for Cook County internship the obstetrical questions were based upon a definite group of facts assembled to represent a clinical case. It was astonishing how many candidates used these clinical facts merely as a point of departure springing immediately to some quiz class assemblage of data which they discussed extensively with no further interest in the governing conditions furnished.

I fear we teachers also are to blame in personal example. When a patient arrives at the Cook County Hospital in the third day of active labor with a diagnosis of carcinoma of the cervix (later not confirmed by laboratory findings) with the membranes ruptured for 48 hours with signs of fetal life not obtainable for at least 24 hours (the fetus being later found macerated) with only a 2 centimeter dilatation of the os, with a maternal pulse rate of 100 at entrance which continues to rise thereafter, and with the fetal presenting part still above the inlet we may, I think, be justified in speaking of this as a neglected case. If such a case were received from the hands of a midwife or indeed from a general practitioner we would use it to illustrate oft quoted evils but she was received after being 3 days in the care of a well organized teaching dispensary.

Again when from another teaching clinic a patient is received after 24 hours in labor with membranes ruptured but with the os still far from being completely dilated, with a history

## SOME COMMENTS ON THE TEACHING AND PRACTICE OF OBSTETRICS<sup>1</sup>

By W. GEORGE LEE, M.D., CHICAGO

Assistant Clinical Professor of Gynecology and Obstetrics, University of Chicago, Visiting Obstetrician, Cook County Hospital

**I**N the curricula of medical schools, the time assigned to the department of obstetrics is no more than that given many other departments dealing with phenomena restricted in occurrence, the duration of which extends over a far longer period and in which there is rarely any element of emergency. Moreover in this allotted time there are at present included many phases basically as closely allied to the medical and surgical field as to the obstetrical.

The abnormalities arising in pregnancy of the type demanding attention in prenatal clinics often require as wide a knowledge of essential medical technique as do labor and its problems and the abnormalities seen in postnatal clinics demand surgical knowledge for proper interpretation and care. The importance of medical and surgical knowledge would justify the prevalent limitation of teaching time in the practice of obstetrics if that time allotted to this subject was utilized solely for making understood the phenomena peculiar to obstetrics particularly those of labor. However as much of the time is taken up now by the primarily medical and surgical phases, the students in the time remaining cannot obtain a grasp of the normal and pathological obstetrical phenomena and their rational management because basically the physiological phenomena are complex and have a great admixture of mechanical elements and these phenomena are dealt with by the obstetrical department alone.

Obstetrical teaching was the principal topic for discussion at a meeting of this society not long ago. What was the result? If what occurred is taken as an index there was only a paucity of interest and an absence of ideas adjudged worthy of discussion. Indeed the principal contribution was a laudation of one course of study in detail as already near the zenith of perfection. The inference seemed to be that there was little need for further search for improved methods. This was depressing

for this praised method of teaching obstetrics would appear to be just as capable of improvement as are the curricula and methods of most other medical schools if judged by the product. Information from men in many institutions corroborates the diagnosis of widespread deficiency in obstetrical preparation whatever the school concerned. The blame cannot be laid upon the students since they show a constantly higher standard of preliminary preparation and mental capacity and so it must be placed upon the manner and methods of teaching.

Perhaps one difficulty may be that to many teachers all facts seem to have equal value. The student burdened by the great multitude of obstetrical facts thrust into his charge is like the overwrought hen trying to brood too many eggs with the result that few hatch because their number exceeds her capacity for keeping them warmed to a germinating temperature. Perhaps teaching departments have been expanded too rapidly, like hospitals so that size has outrun organization and efficiency or else like Topsy they just grew. Perhaps the members of other departments of medical teaching are not acquainted with nor appreciative of the needs for carrying on effectively this peculiar yet fundamental department of the science and art of medicine and hence leave us inadequately supported.

More probably however it is the summation of many different causes for which each individual member of this or similar societies who call ourselves gynecologists and obstetricians is in part to blame. It is true that not all of us are teachers in medical schools but every one of us in this field of our especial interest should be an impartor of knowledge about it. We should be teachers of each other and of those in other fields of medical practice, of internes trying to correlate earlier studies by the direct observation and care of actual patients with responsibility for them of students laying foundations in the class

shown on the top and bottom lines may probably be explained by the fact that the women were largely of the European peasant type

The operative births show variations somewhat dependent upon the personal point of view of the staffs. In low forceps cases the rates vary, the lowest rates being in those hospitals with the greatest number of spontaneous births. This may be due to more rigid indications for interference. Certainly in the Cook County Hospital we believe that the number of such deliveries might well be considerably increased if the progress of labor were more closely followed and the obstetrical acumen of the house staff had been sharpened by more efficient preparation. In this tabulation low forceps include also the mid or median type and we regret that this division cannot be shown for it is our belief that true low forceps (outlet forceps with complete internal rotation) imposes far less strain upon the patient than mid forceps in which internal rotation is not as yet completed. The returns for delivery by high forceps show three hospitals in which this operation apparently is taboo, three other hospitals with close agreement in rate while the Cook County Hospital has a still lower record. The rate from the sum total of the 74 hospitals shows such a marked increase over any of these seven that our interpretation would be that the station of the head was not well known in many cases in other words that difficult mid forceps may have been included in the high forceps classification. The cesarean section rates show three hospitals with rates far above the other four and the lowest rate is in exact agreement with the average from the total 74 hospitals. The highest rate occurs in that hospital with the smallest number of other methods used for delivery when the presenting part is still above the inlet. In version two hospitals are markedly above the others in rate as well as above the average of the 74 hospitals and our appended figures for the series we are reporting is the highest of all. The rates of the seven hospitals based upon the total number of high forceps cesarean section version and extraction cases vary very little.

Three hospitals show the same number of extractions and versions which is what we

would expect. One hospital shows no extractions following versions, while two hospitals show such an increased number of extractions that our interpretation is that the question name was misunderstood for these same hospitals show a correspondingly decreased rate of breech interferences. The rates for breech interferences show that in the smaller hospitals there must be less hesitation in interfering with spontaneous progress. Destructive operation rates show two hospitals that exceed the general rate of all 74. When we remember that these 74 hospitals include a large number absolutely forbidding destructive operations unless the fetus be assuredly dead it would seem that some explanation should be forthcoming to account for this high rate. In one of these hospitals no high forceps were used, perhaps this is the explanation of the increased number of destructive operations. The other high rate occurs in our series and later will be considered in detail.

We now come to our particular series and it may be of interest to show the basis of our analysis.

#### SCHEME USED TO ARRIVE AT FIGURES SHOWN IN TABLE

Service Name	
PREGNANCY	
Date delivered	
Race	
Duration	
Pelvic measurements	Para
Interspinal	
Intercristal	
Intertrochanteric	
External conjugate	
Diagonal conjugate	
Type of pelvis and degree of disproportion	
Presenting part	
Position	
Station	
Systemic complications i. e. cardiac tetraemia etc.	
LABOR	
Onset induced method	
Character of uterine contractions	
First stage	
Second stage	
Duration	
First stage	
Second stage	
Third stage	
Total	



of attempted operative delivery by forceps, although the presenting part is still above the inlet when no valid reason for operative interference is found after her admittance except this unsuccessful invasion of the birth canal and when she delivers herself spontaneously about 4 hours later with no indication for interference in the intervening time, should we be satisfied with our teaching? When a patient after 3 previous deliveries cared for by midwives without noticeable disability resulting passes through a teaching clinic from students upward finally to emerge after laparotomy without her uterus because a laceration in the introitus from an attempted forceps extraction had caused hemorrhage and dismay should not each of us become diligent in acute observation and analysis confer about possible improvement and cease throwing stones at those who conscientiously question dictums who want to be shown the validity of new methods before abandoning time tested ones? When recent graduates have frequent unattended births "precipitate labors" as they delight to call them because they cannot or do not judge aright the rate of progress in cases relatively normal in all factors, who show much greater familiarity with infrequently needed procedures of still disputed worth than with the simple maneuvers almost constantly required does it not behoove all of us to look for adequate correctives for such faulty results?

### THE PRACTICE OF OBSTETRICS

The obstetrical division of the Cook County Hospital has 4 visiting staff members each of whom teaches in a different medical school. The service of the house obstetricians is relatively short and there are several different ranks in varying parts of the division but without continuity. These house obstetricians, coming from various schools use different nomenclature and obstetrical procedures. Their services do not overlap so that there is little opportunity to secure continuing uniformity of technique. One result of this is that the records do not lend themselves well to statistical use.

During the residency of Dr. J. H. Gernon from January 1 to July 1, 1924, we attempted

to tabulate and analyze all cases of interest. These were culled from a total of 1,268 maternity cases of which 1,008 were in Ward 51, 176 were in Ward 50 and 71 were from the venereal segregation ward. In addition there were 13 cases of cesarean section, which will be reported later by our fellow member Dr. Henry F. Lewis who is making a detailed study over a much longer time.

Before taking up the results of this analysis let me present a tabulation derived largely from statistics obtained from the department of health of the City of Chicago, of which Dr. Herman N. Bundesen is commissioner. These statistics were from a survey of Chicago hospitals instituted by Commissioner Bundesen's advisory committee of prenatal activities. These statistics showed the number of spontaneous and operative deliveries cared for by each hospital during the year 1923. The present tabulation consists of those figures reduced to the rate per 1,000 to afford a better comparison. Only seven hospitals are cited chosen both because of the number of patients they cared for and because their obstetrical services are distinct. All seven hospitals are represented in this society. The sum total of all the 74 hospitals included in this survey was reduced to the same basis and added. Our cases at Cook County Hospital have been reduced to the same scale and appended to this tabulation.

### NORMAL AND OPERATIVE DELIVERIES IN HOSPITALS

Figures = Number per 1,000 Cases

Spontaneous	For Low Force	High Force	Cesarean	V. vs.	Extractio	Placenta	De- tails
953†	13	3	8	4	4	15	2
763	163	10	26	12	12	10	2
764	184	0	10	20	0	16	4
845	204	13	10	14	12	0	2
837	107	13	13	6	18	5	1
744	174	0	19	20	20	25	0
766	135	0	42	2	15	39	2
761	146	34	9	12	12	14	3
905†	30	7	11	28		15	4

†H. H. D. partment figure 1.

1000 per

All versions w. r. f. f. wed by tract

We realize that the figures in our table give very limited information. The number of spontaneous births in 4 hospitals substantially agree. The rates above the average of spontaneous births at Cook County Hospital

manual rotation. In 11 cases scopolamine morphine was given to banish memory, in 6 small doses of morphine during the labor and in 1 digitals (We would call particular attention to the number of cases of oligohydramnios because we have found this condition a fertile source of delay. In our opinion it exceeds dry labor in importance because it has received scant attention and therefore is rarely diagnosed although it results in the same difficulties that dry labor may cause.) Of 2 cases delivered spontaneously 1 was admitted after attempted delivery by high forceps outside. The pelvis was flat in type and the maternal pulse rather high and the head was already well advanced. The baby died in 6 days from a depressed skull fracture which was elevated after birth. The other patient came in in active labor with a face presentation and near the end of the first stage. The face was converted to a vertex and the birth of a 10 pound baby in good condition occurred without further delay. In several cases the labor was of considerable duration. The only reasonable explanation is that the condition of both mother and child remained good throughout for no fetal or maternal deaths resulted. I may here note that all scopolamine morphine cases reported are from one service.

Low forceps cases in this series are those in which internal rotation was complete so that the obstacle to progress was either bony or soft tissue of the outlet. One of these low forceps was secondary to pubiotomy. Of the 21 primary low forceps 15 were in primiparae. All had complete effacement and dilatation of the os and there were no fetal deaths. The one maternal death in the series resulted from pinal anesthesia and the delivery of the child by forceps was done only because and after the mother was in *extremis*. Other factors of interest cited in the records are no co-operation of the patient 1 rigid perineum, 3 high blood pressure 1 cardiac pathology 1 pelvis flat in type 1 and just minor 1. In all cases there was second stage delay. In addition 1 prolapsed arm and 1 manual rotation received necessary preliminary treatment. There was one case in which the occiput was posterior from mal rotation. The cases showing inertia were 1 early rupture of the mem-

branes 2 dry labor, 2, oligohydramnios, 2, postpartum hemorrhage, 2 signs of maternal exhaustion, 11 of fetal exhaustion 4 8 episiotomies were done and there were 5 first degree tears.

Of the 15 mid forceps cases 1 was secondary to pubiotomy. In all of the 14 cases of primary mid forceps the cervix was effaced, but in 2 dilatation of the os was not complete when interference was started. Of the 14 13 were primiparae there was 1 cardiac case 1 complicated by dermoid cyst and 1 by multiple fibroids. One was the first of twins. There were 3 deep arrests, 2 had just minor pelves.

Complications in labor. There were no inertia cases, no dry labors in 3 the membranes ruptured early in the first stage in 5 oligohydramnios was present. Signs of maternal exhaustion occurred in 11, of fetal exhaustion in 2. One episiotomy was done in 3 cases there were first degree tears and in 2 second degree tears. The average duration of the low forceps cases was 18 hours first stage, 2 hours 20 minutes second stage 20 minutes third stage. The average duration of the mid forceps cases was 21 hours first stage, 2 hours 12 minutes second stage 16 minutes third stage. To bring together the less serious interferences and the spontaneous abnormal cases we will add 16 breech presentations. In 1 breech case with spontaneous delivery and a macerated fetus, toxemia developed. Of 15 breech cases receiving some assistance 10 were primiparae 5 cases were of the footling variety and in 2 of the cases the babies were macerated.

We now come to that 5 per cent of serious interferences. There were 9 high forceps deliveries 1 secondary to pubiotomy. Of the 8 primary high forceps cases 1 was a primipara 1 was a neglected brow with an undiagnosed papyraceous twin weighing about 2½ pounds. In 3 the pelvis was flat in type in 2 there was delay in both first and second stages in 5 cases in the first stage and in 1 case in the second. Inertia was present in 2 dry labor in 2 oligohydramnios in 4 polyhydramnios in 1. Postpartum hemorrhage needing subsequent intrauterine packing occurred in 2 signs of maternal exhaustion in 5 and of fetal exhaus-

Placental birth  
 Spontaneous  
 Expression  
 Manual removal  
 Subsequent uterine treatment

Laceration or episiotomy  
 Repair  
 Result

### COMPLICATIONS OF LABOR

Lack of progress  
 Stage of delay  
 Inertia of uterus  
 Rigid cervix  
 Bag of waters unruptured after first stage  
 Bag of waters ruptured early first stage  
 Dry labor  
 Oligohydramnios  
 Polyhydramnios  
 Constriction ring  
 Abnormal presentation  
 Threatened rupture of uterus  
 Maternal hemorrhage  
 Antepartum  
 Intrapartum  
 Postpartum  
 Signs of exhaustion  
 In mother  
 Uterus  
 Pulse  
 In fetus  
 Meconium  
 Heart tones  
 Caput succedaneum  
 Forelying funis  
 Prolapse of funis

### OPERATIVE DELIVERY

Hours in labor  
 Clinical—Stage of interference  
 Condition of cervix  
 Dilatation of os  
 State of bag of waters  
 Station of presenting part  
 Operation preparatory to extraction  
 Delivery operative method  
 Anæsthetic used and duration  
 Immediate maternal result  
 Remote maternal result

### CHILD

Cord about neck  
 Short cord  
 Asphyxia  
 Lived  
 Pallid  
 Resuscitation method  
 Injury or deformity  
 Final result  
 Sex  
 Weight

### REMARKS ON PUERPERIUM

The arrangement shown in our schema has proved of great interest to us and we suggest its careful consideration by others. If in each hospital a summary of all labors were entered on such a form as soon as each labor was finished and particularly if the different varieties of delivery were separated and on distinct sheets a mine of information would be quickly amassed having great worth especially if the terms therein were standardized so that they represented like things.

Out of the 1268 cases already mentioned 12 were delivered by low forceps, 15 by mid forceps and 9 by high forceps, 35 by version and extraction. There were 20 breech presentations in which manual extraction was done. There were 15 breech presentations in which some manual aid was given and 1 in which birth was completely spontaneous. There were 6 pubiotomies done, 5 destructive operations on the offspring, and 13 cesarean sections. Of 8 pairs of twins one pair required operative delivery. There were 86 protracted labors of over 24 hours duration but with spontaneous birth.

The 122 operative interferences give a percentage of 9.5 which coincides with the tabulation rate already made in comparison with the other hospitals, 67 (5 per cent of the total) were of serious nature. In the protracted yet spontaneous labors numbering 86 cases, 58 were in primiparae in 55 the fetus was in occiput left anterior position in 11 the pelves were just to minor in type in 1 just to major in 7 flat and in 1 there was high blood pressure. There were 3 cases of lues in 2 of which the fetus was macerated. Among the abnormal conditions were 84 cases of delay in the first stage and 2 in the second stage delay occurred in 53 with the head distinctly high. The cause of delay in 47 cases was inertia in 9 cases signs of maternal exhaustion as indicated by rising maternal pulse. There were rigid cervixes in 4 cases, dry labors in 15, rupture of the bag of waters early in the first stage in 9 and oligohydramnios in 14. Four babies showed marked caput succedaneum. Four episiotomies were done and there was one tear of the second degree. There were 2 cases of artificial rupture of the bag of waters, 1 of dilatation by hydrostatic bag and 1 of

when we state that the one service in which this last group occurred is headed by an avowed admirer of Potter, and in addition we may say that on this same service were all the cases receiving scopolomine morphine or twilight sleep, as well as all pubiotomies but one. There the resident in an emergency elected to follow this method. This should be borne in mind when the pubiotomies are analyzed.

The primary manual extractions which occurred in 20 breech cases show the following items of interest. There were 6 footling extractions, in 2 cases there was a prolapse of the cord, and in 14 cases breech presentation, one with prolapse of the cord. There were 10 primiparæ and 10 multiparæ. 2 toxæmia cases, 2 dead fetuses with heart tones not having been heard during the labor. 1 case of intrapartum hæmorrhage from ablatio placenta occurring before entrance to the hospital. 1 of postpartum hæmorrhage. In 5 cases there were signs of maternal exhaustion. In 1 of fetal there was 1 case of inertia. 1 with early rupture of the bag of waters. Of the other 3 dead babies 1 death was the result of ablatio placenta. 1 the result of marked delay in getting down the feet. 1 was a case of pallid asphyxia with a cleft palate as already mentioned, in 2 no heart tones were heard at any time in the hospital. 1 fetus being macerated. There was 1 manual removal of the placenta. The most severe of these cases from the maternal standpoint was the one of ablatio placenta. This patient was received in very poor condition but recovered.

Pubiotomy was performed in 6 cases. In 2 before the approach of labor. One of the 2 patients was afflicted with tertiary lues. In the other the pelvic measurements in centimeters were interspinal 21.5 intercrural 23 intertrochanteric 27.5 external conjugate 18 transverse conjugate 11.5. She had an easy and rapid delivery of a 5 pound 14 ounce baby. In the other case of spontaneous delivery the pelvic measurements were interspinal 22 intercrural 24 intertrochanteric 31, external conjugate 19. The weight of the baby was 5 pounds 3 ounces. All 3 of these patients were primiparæ. In the fourth pubiotomy the measurements were 21 26 30 and in the patient was a *u para* the baby weighed

5 pounds, 10 ounces and required mid forceps to complete delivery. The fifth was also a *u para*, with measurements of 22 23 29 18.5 and diagonal conjugate of 11 centimeters. The baby weighed 6 pounds, pubiotomy was done about 9 hours after the onset of labor and the baby was delivered by high forceps 7 hours later. This patient had scopolomine morphine.

The emergency case in which pubiotomy was done was a *u para* who was brought to the hospital after 24 hours of labor with face presentation and fetus high in station. The diastolic blood pressure was 185 systolic, 130. There were present marked oedema respiratory infection and a toxic adenoma. The measurements were 25 28 29 18, and 10. Under either the face presentation was converted to a vertex and then a high forceps extraction was attempted. After  $\frac{1}{4}$  grain morphine had been given, and the patient had rested for 3 hours a pubiotomy was done. Low forceps were used for final delivery. A 6 pound child was born in pallid asphyxia but neither mother nor child survived long.

The destructive operations numbered 5 in this series with one maternal death. The death occurred in a primipara with a breech presentation and a true conjugate of 10.5 centimeters. She was suffering from eclampsia hypertension nephritis cardiac decompensation and very marked obesity. No fetal heart tones were obtainable. She was admitted after having been in labor almost 2 days and in very senous condition. At the time of interference marked signs of maternal exhaustion were present. The os was incompletely dilated therefore a preliminary dilatation by a Voorhees bag was followed by manual dilatation. Embryotomy was followed by craniotomy done on the after coming head. The mother died 4 days later.

The other 4 destructive operations were done by the writer. Three were craniotomies one done upon a hydrocephalic baby from whose head 500 cubic centimeters of fluid was obtained after 42 hours labor in the care of a midwife. This case showed signs of threatened rupture of the uterus a Bandi's ring being apparent. There were signs of maternal exhaustion the pulse being 130 when patient was

tion in 2 2 episiotomies were done and in 2 there were first degree tears. Apart from the neglected case 2 fetal deaths resulted. One was a 12 pound baby, and 20 minutes were lost in delivering the shoulders, the other was an 8 pound baby delivered with occiput posterior. The mother had received scopolamine morphine anesthesia and had worn an abdominal belt for 2½ hours to assist expulsive efforts. Inasmuch as the case of neglect resulted in maternal death in 7 days from general peritonitis and in the baby's death in 2 days and delivery was by the author, further details are given. After 30 hours labor in an outside teaching clinic the patient was admitted to Cook County Hospital upon another service where she received scopolamine morphine anesthesia for 7 hours. At this time I was asked to see the case. The presentation was longitudinal but the presenting part supposedly vertex was found to be a brow presentation. The uterus had been dry on admission. At this time there was complete effacement of the cervix but a dilatation of only 4 centimeters. Manual dilatation preceded the conversion of the brow to a face for the retraction of the uterus prevented successful extension of the head. A very slow extraction was done thereafter for our belief is that the real impediment to fetal exit from the uterus could be safely overcome only by timing out the constriction ring. After this tedious part was accomplished extraction through the bony pelvis occurred without incident. The papery raceous twin was delivered 20 minutes later in an intact and distinct sack. The fetal head was markedly molded from its long stay as a brow but only livid asphyxia was present. The postmortem examination of the mother disclosed no injury of the uterine walls.

There were 35 cases of version followed by manual extraction. 13 of these patients were primiparae, 19 multiparae, 3 unspecified. There were 6 cases of antepartum bleeding, 3 from placenta prævia marginalis, 1 from placenta prævia centralis, 1 from ablatio placentæ and 1 from cervical laceration. In one of the cases of placenta prævia marginalis in which the pelvis was of the justomnor type the fetus presented transversely with a prolapsed hand. There were 7 other transverse

presentations, 2 with a prolapsed arm and 1 with a prolapsed cord. There were 2 cases with brow presentation, 1 case of toxæmia, 1 of eclampsia, and 1 with signs of maternal exhaustion. One was the second twin. Two pelvises were justomnor in type and 3 were flat.

The complications of labor include 4 cases of inertia, 2 dry labors, 3 cases of early first stage rupture of the membranes and 2 of constriction rings. In 5 there was threatened uterine rupture.

The method of treating the antepartum hæmorrhage varied, although all were first stage interferences. In 2 cases of placenta prævia marginalis the bag was inserted and 1 live baby delivered. In 2 cases of Braxton Hicks version 1 baby survived, but in the other a case of placenta prævia centralis, the baby died. In the 1 case of ablatio placentæ a bag and a Spanish windlass were used and the baby was dead. In 1 case in which the bag and manual dilatation of the cervix were used the baby was macerated. Of all other cases in the series 2 babies died in 2 days, 1 baby died in 4 days, 1 baby was macerated and 1 baby (in the eclamptic case) was dead when received. Three placentæ were manually removed.

We think it only fair to discuss the reason for this large percentage of version and extraction cases, actually 35 in number, because out of these 35 cases 21 are chargeable to one service, the remaining 14 being distributed as equally as possible among the other three services. Twenty of the total number of cases show the classical reasons for interference. Of the remaining 15 all on one service, the reasons for version are not very clear from the records unless one postulates a predilection for this method of delivery. In all of the 15 cases there was skull presentation in 11 a posterior position of the occiput in 2 inertia in 8 ruptured membranes in 1 a dry labor with a constriction ring after an initial polyhydramnios and here interference was instituted after 56 hours of labor. The mother was in poor condition after delivery but recovered. The baby was one of those who died in 2 days. In 6 of these 15 interferences manual dilatation before version was done in the first stage. We believe we are not misrepresenting conditions

when we state that the one service in which this last group occurred is headed by an avowed admirer of Potter, and in addition we may say, that on this same service were all the cases receiving scopolomine morphine or twilight sleep, as well as all pubiotomies but one. There the resident in an emergency elected to follow this method. This should be borne in mind when the pubiotomies are analyzed.

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admitted. Maternal recovery was uneventful. The other 2 cases of craniotomy followed tentative traction by high forceps. One was a case of dry labor with signs of maternal and fetal exhaustion. The first stage of labor had lasted 68 hours with a dilatation of the os of only 5 centimeters. She was a vi para with measurements of 26 28 30 17.5 and a true conjugate of 11.5 centimeters. The fetal head was unmovable from excessive ossification. Craniotomy resulted in maternal convalescence without incident. The remaining craniotomy was done after labor had lasted 37 hours, the head was still high and the fetal heart tones had disappeared. Maternal recovery was uneventful although the pulse was 110 at the time of interference.

All these cases may be fairly called neglected, being received in very bad condition. The final case must also be so classified although the neglect was in part ours. Faulty diagnosis of the presentation resulted from too long use of rectal examination alone. This was a primipara with normal measurements, having an active gonococcal infection as well as a pronounced growth of condylomata around the whole introitus. A diagnosis of footling presentation was made by rectal examination. Early rupture of the membranes had occurred before entrance into the hospital. Lack of progress for 14 hours thereafter with a rising fetal heart rate finally resulted in

a vaginal examination and at this time the true diagnosis was made of a transverse presentation with a hand over the os. When I saw the case the uterus was tightly retracted upon the fetus and the fetal heart tones were abnormally high. A decapitation was followed by a craniotomy. The weight of the parts of this baby after delivery was 8 pounds. The mother had an uneventful convalescence.

#### CONCLUSION

In conclusion I would call attention again to the fact that at Cook County Hospital we have to receive patients in every stage of labor, no matter how serious the condition and that the total number of neglected cases forms a very considerable factor in our operative results, and to point out as well that no control is possible over individual practices of the attending staff on the different services. Under such conditions we think that this analysis and the results shown will conclusively refute the popular belief formerly so wide spread, that at the Cook County Hospital operative interference is often done without proper indication and is resorted to vastly more frequently than in hospitals under private control. We think that this report shows convincingly that as a whole the Cook County services are decidedly conservative and that in general the indications for major operations are definite and valid.

ROENTGENOGRAPHIC DIAGNOSIS IN GYNECOLOGY,  
PNEUMOPERITONEUM<sup>1</sup>

BY IRVING F. STEIN, M.D., F.A.C.S. CHICAGO

Mich. I. Reese Hosp. t. 1

F. m. the Ad. lph. Ste. a M. m. rat. for R. arch. in Roe. tg. l. y

**A**LTHOUGH it is 13 years since Weber and Lorey independently described the adaptability of the abdominal viscera to roentgenography after pneumoperitoneum and although Orndoff Stein and Stewart Alvarez and many others have made valuable contributions to the perfection and scope of the method the gynecologist is still skeptical as to the value of roentgenography in his work. The reason for this is that the soft genital organs are not generally thought of as being adaptable to roentgenographic diagnosis and therefore little attention has been given this subject. The size and shape of the pelvic viscera and their relationships, their varying densities and organ outlines are the factors of diagnostic importance. These points can be brought out on the roentgen film under certain favorable conditions.

Before taking up a relatively new method of diagnosis the careful physician might well ask himself the following questions: Can the internal genitalia be clearly and accurately outlined on the roentgen film? Is the roentgen film of any value in addition to the clinical and other laboratory findings? Is the procedure harmful to the patient? Can any gynecological condition be thus recognized that may escape recognition with the usual diagnostic means? Should roentgenography be employed routinely in gynecological diagnosis?

These questions can best be answered by citing cases in point and will be treated in the conclusions.

The gynecologist arrives at a diagnosis usually after careful history taking, a bimanual vaginal and rectal examination and inspection of the vagina and cervix through the speculum. He utilizes smears, cultures and serological tests, the sound and the cystoscope as his judgment dictates. In spite of care and skill errors in gynecological diagnosis are so common that the physician welcomes any new method of precision which can be safely used to reduce errors to the minimum. The

fact that extra skill and time are required of the physician and that it imposes additional expense upon the patient should not exclude a method which possesses merit. Roentgenographic diagnosis is one of the newer methods of the past 5 or 6 years which enhances accurate diagnosis in gynecology but which is not commonly utilized for this purpose. To Reuben Peterson belongs great credit for clearly demonstrating the practical adaptation of this diagnostic method to gynecology. Working with the late Dr. Van Zwaluwenberg in Ann Arbor he utilized the partial knee chest posture (Fig. 1) for obtaining accurate optical cross sections of the pelvic organs on the roentgen film and reported a series of 300 cases to the American Gynecological Society in 1921. He also recommended the utilization of Rubin's patency test for transuterine inflation of the abdomen in suitable cases.

Following the Peterson technique I have made use of roentgenography in my gynecological diagnostic work in the past 2 years with so great a degree of satisfaction that I desire to emphasize some of its advantages.

In this field of diagnosis as Peterson brought out, team work is requisite for success. Neither the roentgenologist nor the gynecologist working alone can achieve the results that are obtained by their co-operation. I have utilized carbon dioxide through the Rubin patency test apparatus for inducing abdominal inflation both by transuterine and transabdominal routes. About a litre of gas is usually introduced. This method was used in over 150 consecutive patients with no accidents or untoward results. The only complaint from our patients was the "shoulder pain" which often distressed them a few days but which could be relieved by assuming the recumbent posture.

We again followed Peterson in the plan of study of our cases, namely a provisional diagnosis was made after the usual gynecological examination, then pneumoperitoneum was

<sup>1</sup>Read before the Chicago Gynecological Society, June 29, 1925.



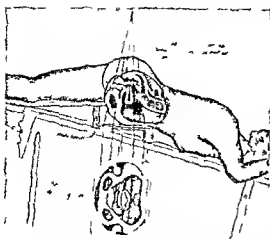


Fig 1. Partial knee-chest posture for pelvic roentgenography after pneumopentoneum. (From Peterson.)

induced upon the X-ray table the partial knee-chest posture was arranged and stereo roentgenograms were made. A diagnosis was made independently by the roentgenologist from the roentgenographic evidence alone. After a joint study and discussion of the films the clinical and roentgenological evidence was correlated. In the operative cases the diagnosis was finally checked up when the abdomen was open. The interpretation of the films was indeed the most difficult part of the investigation and we confess to many errors in our early diagnoses. With greater experience

we are becoming more familiar with the roentgen aspect of pelvic conditions and we are often surprised at how readily we now recognize certain pathological conditions and how much oftener we agree.

By using the Potter Bucky diaphragm we have obtained even greater detail than did Peterson and in addition to the uterus and ovaries we visualized in some cases the normal fallopian tubes, round and broad ligaments, bladder and adhesions.

The following conditions have been compiled from our pneumopentoneal diagnoses.

	Cases
Normal genital status	12
Hypoplastic uterus	2
Immature uterus	2
Bicornuate uterus	1
Uterus duplex	1
Displaced uterus	7
Ventrally fixed uterus	3
Early pregnancy	10
Ectopic pregnancy	5
Pseudocyesis	2
Fibroids	8
Ovarian cyst	13
Papillary cystadenoma of ovaries (malignant)	1
Tubo-ophoritis	5
Chronic salpingitis	6
Frost in pelvis	1
Adhesions	24

We failed to obtain diagnostic films in 2 cases because the gas was injected subperitoneally wholly or partially. These were in



Fig 2a. Drawing showing normal genital status in patency test for sterility.

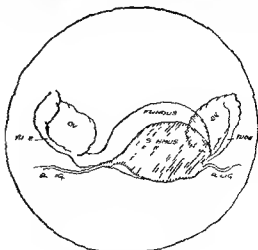


Fig 2b. Diagram of Figure 2a showing normal genital status in patency test for sterility.

badly behaved subjects. Some films were of no value because of radiological technical errors. The technique had to be evolved.

To emphasize the value and usefulness of roentgenography after pneumopentoneum the following cases from the above list, with illustrations are reported.

**CASE 1** Fig 2 reveals a normal genital status obtained after performance of the patency test in a case of sterility of 12 years. This illustrates that great detail is obtainable by this method of roentgenography. The uterus fundus and isthmus in cross-section ovaries tubes and round ligaments are clearly seen.

**CASE 2** In contrast to the first case the normal genitalia of a girl of 13 years are depicted in Fig 3 in whom transabdominal pneumoperitoneum was performed to disprove a suspicion of pregnancy. The first menstruation occurred May 1923. After three regular periods she skipped three periods. The family physician thought that she was pregnant and brought her to us for a verification of his diagnosis. The size of the uterine shadow and absence of Peterson's sign of early pregnancy indicated that she was not pregnant. The negative finding in this instance has great diagnostic value aside from the immeasurable mental relief to the parents. Rectal examination would not reveal the condition with the same degree of positiveness.

**CASE 3** Fig 4 depicts the pelvis of a patient admitted to the hospital with the clinical diagnosis of fibroids. She complained of metrorrhagia and pelvic pain. Two previous operations had been performed one for pus tubes and the second for

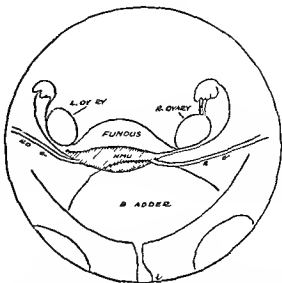


Fig 3 Normal genital status 13 year old girl. Question of pregnancy settled definitely in the negative by the film evidence.

ovarian resection. Palpation revealed a firm mass in the entire pelvis; a tender uterine fundus in Douglas cul de sac adherent to the mass. Laparotomy revealed conditions just as depicted in the roentgen film: namely large left and smaller right ovarian cyst, retroverted uterus and adhesions. Total hysterectomy and double oophorectomy were performed.

**CASE 4** Fig 5 depicts the findings in another patient in whom transabdominal inflation was per-

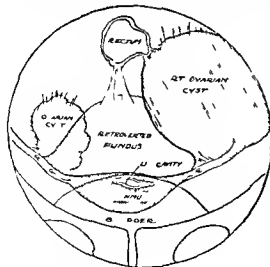


Fig 4 Bilateral ovarian cysts retroverted uterus. Adhesions.

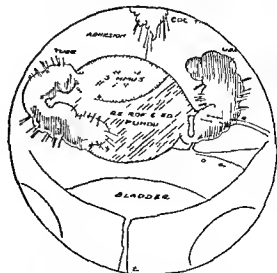


Fig 5 Chronic salpingitis with adhesions retroflexed uterus.

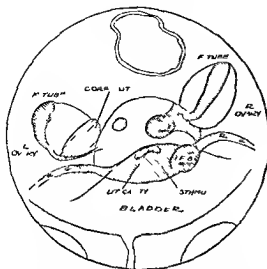


Fig 6 Multiple fibroids retained ovarian tissue. Clinical picture of ectopic pregnancy. Tubes definitely normal in film

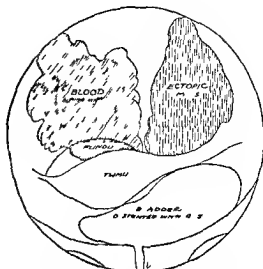


Fig 7 Ruptured ectopic pregnancy. Patient very obese. History and physical findings confusing. Film diagnostic

formed. She was a nurse age 29 single and complained of pelvic pain. There was no history of a previous inflammatory process. Examination revealed a firmly fixed retroflexed uterus adherent to bilateral pelvic masses which were firm and tender. The clinical picture was not that of an acute process. The films clearly reveal bilateral tubal swellings and an apparently enlarged adherent uterus. The magnification of the uterine shadow is produced by its retroposition having been considerably farther from the film than normal. Salpingectomy and Gilliam's round ligament suspension of the uterus were performed.

CASE 5 Fig 6. This patient was a young woman age 26 years who had one child 5 years ago with an uneventful interval history until the present complaint. Her last menstrual period was 9 weeks ago. She felt well until 2 weeks ago—3 weeks after the missed period—when she began to bleed. This was at first just a spotting and it was accompanied twice by fainting. Pain had not been severe but there was a constant low backache and some left sided abdominal pain. Upon examination the uterus was found to be erect slightly enlarged and softer than normal irregular in consistency and the left adnexa extremely tender soft but not palpably enlarged. Palpation was made very gently to avoid rupture. When the patient was informed that the impression was that of an ectopic pregnancy she informed me that she had been to two obstetricians previously and that both had diagnosed the same condition. She wanted to know how one could be more positive however before submitting to surgical exploration consequently transabdominal pneumoperitoneum was induced and pelvic roentgenograms made.

The interpretation of these films was by no means simple for although the uterus and both adnexa show clearly on the films only by studying them stereoscopically did we come to the diagnosis of uterine fibroids and probable normal adnexa. In view of the acuteness of the disturbance however and the previous opinions rendered it was deemed advisable to explore the pelvis. At operation the adnexa were found entirely normal. The left ovary contained a recent corpus luteum. The uterus was enlarged and contained several intramural fibroids from 1 to 2 centimeters in diameter which were removed. One seemed to be submucous and in an attempt to isolate the latter nodule the uterine cavity was opened and it was found that this supposed fibroid was a piece of necrotic ovarian tissue about 1.5 centimeter in diameter. This then explained the lapsed period and the recent corpus luteum found at operation as well as the metrorrhagia. The patient denied however that an abortion had been performed or that any material resembling the ovum had passed previously.

CASE 6 Fig 7. A woman 30 years of age who had been bleeding continuously and more or less profusely for 4 weeks came to the hospital solely because of this hemorrhage. Her previous menstrual history was uneventful and she had not missed a period. She was very obese so that rectal examination revealed little except pelvic tenderness and a sense of fullness. Subjectively there was some abdominal pain of an indefinite nature weakness but no definite symptom complex. There was nothing at all suggestive of pregnancy in her history. Inasmuch as the history and local findings were indeterminate it was decided to seek roentgenographic aid

Transabdominal pneumoperitoneum was induced a litre of carbon dioxide being introduced into the peritoneal cavity and roentgenograms taken of the pelvis. As you perceive from the diagram there is a definitely circumscribed mass in the right half of the pelvis. Below this the cross section of the isthmus and cervix of the uterus can be identified and the gas distended bladder is seen anteriorly. The left half of the pelvis is occupied by a shapeless irregular mass resembling clouds on the film. This is quite characteristic of blood and clot in the peritoneal cavity. The fundus of the uterus is completely obscured by the aforementioned shadows.

On the basis of the roentgen findings laparotomy was performed and a right tubal pregnancy was removed. There was about a pint of blood and clot in the belly.

The statement that the most typical thing about an ectopic pregnancy is that it is atypical is certainly borne out in this case in which uterine bleeding was the only clue to its presence aside from the roentgenographic evidence on the film after pneumoperitoneum.

### CONCLUSIONS

1 Roentgenography after gas inflation of the abdomen is of material aid in gynecological diagnosis.

2 It is not a routine measure the usual gynecological examination sufficing ordinarily.

3 In obese uncooperative ignorant or mentally deficient women it may be the only means of accurate diagnosis before operation.

4 Its value lies not alone in positive evidence but also negatively in allaying suspicion of pregnancy or pelvic lesions with few palpatory findings. As a matter of record it has great value.

5 It is a safe method—no accidents occurring in our series of about 150 cases (Peterson's over 300). Two accidents per 1,000 are reported in the literature (Coliez).

6 The uterus ovaries and fallopian tubes round ligaments and bladder can be clearly depicted on the X-ray film by a careful technique.

7 Pelvic pathology is graphically shown by silhouetting the viscera on the film after surrounding them with gas. Tumors are readily differentiated.

8 Carbon dioxide is preferred to air or oxygen because of more rapid absorption. All three gases are safe.

9 The transuterine route is preferable when the Rubin test proves the tubes permeable. The latter procedure is of distinct value in sterility both diagnostically and therapeutically.

In our hands the roentgenogram was in some instances the sole means of accurate diagnosis. In others it was the deciding factor in settling differences of opinion. In still another group it portrayed normal pelvic viscera when history and opinion indicated otherwise and proved of great value as a matter of record.

I am greatly indebted to Dr. R. A. Arens, roentgenologist at Michael Reese Hospital for his patience interest and support under whose directions all of our films were taken.

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## DERMATOLYSIS

## A REVIEW WITH REPORT OF A CASE

By HERMAN GOODMAN M.D. B.S. AND EUGENE F. TRAUB M.D. B.S. NEW YORK CITY  
 With the aid of Dr. Charles M. Williams

THE subject of dermatolysis is a complicated one. Under this title a number of abnormal skin conditions have been described in the literature and reviewed in textbooks. Recently we have observed a case which we considered an example of the localized or circumscribed form of dermatolysis and we are taking this opportunity of reviewing dermatolysis and describing our own case both clinically and histologically.

Dermatolysis is regarded as a rare disease. It is variously known as loose skin, *cutis laxa*, *cutis pendula*, *pachydermatocele* and *chala-zoderma*. The partial or circumscribed form of dermatolysis is characterized by areas of hypertrophy and looseness of the skin and subcutaneous tissues. The affected area of skin may hang in loose folds or be sufficiently elastic to allow of stretching. The appearance of the surface of the integument may be normal, hyperpigmented with dilated and gaping follicles or comedones. The skin is usually thickened but exceptionally it is thinner than normal. On palpation one gets a doughy or velvety soft feel of a greasy uneven surface. The sensation may be unaffected or hypersensitive. There are no subjective symptoms. Although any part of the body may be affected the locations most frequently involved are the face, especially the eyelids, the neck, the abdomen and the genital region. The condition is somewhat progressive. After reaching a certain stage of development it may remain stationary.

The etiology is unknown. In certain instances the condition is congenital, in others hereditary (several generations), but usually it is acquired. The starting point may be the site of former trauma and the vague term of "trophoneurosis" has been applied to the causation.

The diseases which may be confused with dermatolysis include diffuse dermatolysis or *cutis hyperelastica*. The elastic skin or

indiarubber man of the circus side show is an excellent example of this form of dermatolysis. Here the integument is generally loosely attached to the subcutaneous tissue and has the property of great distensibility occurring normally in the young of certain animals as kittens. Diffuse dermatolysis has been studied by a number of observers.

Dermatolysis must not be confused with the relaxation of the skin and subcutaneous tissues encountered in senility and after pregnancy. In both of these hypertrophy of the constituents of the skin is lacking. Nævi and sebaceous cysts are readily distinguished by the absence of the features of true partial or circumscribed dermatolysis. The relaxation and hanging in folds of the skin are features of *pseudoxanthoma elasticum* but associated papules and plaques are absent in dermatolysis. Whether or not to include fibroma pendulum in the group of circumscribed dermatolysis is indeed a problem. We consider that the pre-existent tumor is not a feature of localized dermatolysis and on this ground exclude fibroma pendulum as well as the depressible fibrous tumors associated with so-called von Recklinghausen's disease and the benign multiple new growths of Schwannner-Buzzi.

The histological features of partial dermatolysis are hypertrophy of all portions of the skin, especially an increase in the fibrous bundles. The subcutaneous tissue shares in the general hypertrophy.

There is no tendency to spontaneous involution. Treatment is purely surgical. There is no tendency to recurrence.

Examination of the prepared sections from our case revealed that the greatest abnormality existed in the derma. It was markedly broadened. Swirls of loose fibrous tissue occupied four or five times the normal area of derma. The tissue was in cross section, longitudinal and irregular. Clear areas of

cedema were interspersed between layers of fibrous tissue. Nuclei were sparse compared to the number of fibers. Numerous small capillaries were seen with normal walls. The lumen of the capillaries were dilated but empty of cellular content. Branching of some of the capillary vessels was seen.

The hair follicle and sebaceous glands present were broadened and somewhat lengthened.

Several islands of epidermic cells about a third way down in the derma were present. No connection with the epidermis was found.

The papillary bodies were insignificant. Along most of the section the papillary bodies were irregular.

The line between the derma and epidermis was demarcated by a line of hyperæmic vacuolated cells of the pigmented basal layer.

The epidermis was thinned. The prolongations down of the pegs were irregular, some times branched but never conglomerate. The surface was in distinct folds. The horny layer was adherent within the folds and filled the pits. Over the hair follicle the surface was indented and filled with a veritable keratotic plug. The summits of the folds were practically free of horny layer cells. The keratinization was normal.

The Malpighian layer was much thinned, varying from five to ten cells thick. The cells were rather closely packed without much separation of the prickles. There was a clear space about some of the nuclei.

The cells of the basal layer were swollen. The cell protoplasm was almost ballooned with fluid and the nuclei sometimes were to one side and sometimes in the middle. The pigment granules were restricted to the basal layer cells but the pigmentation was distinctly increased.

What little subderma there was present in the section showed dilated vessels of normal thickness. The sweat glands were of normal appearance.

The Weigert elastic tissue stained sections showed the elastic fibers directly beneath the basal cells layer to be practically continuous. The fibers were thicker than normal, curled, and branched. Other elastic tissue fibers seemed crumbled. In the derma proper the

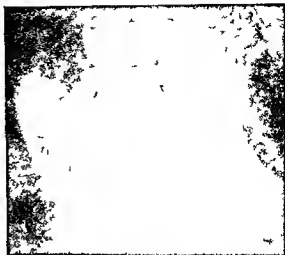


Fig 1 Photograph showing lesion on author's patient

amount of elastic tissue fibers present seemed small. The circumvascular elastic fibers were normal in thickness. In the neighborhood of the hair follicle and sebaceous glands the elastic fibers were more numerous.

**CASE REPORT** Miss F. F., an American born school girl 15 years of age first presented herself to the clinic of the New York Skin and Cancer Hospital August 13, 1924. Her family history was negative except that a sister had had an erythematous eruption probably toxic in nature which disappeared spontaneously. Her past history had no bearing on the condition presented. As far back as the patient or her parents remembered probably from earliest infancy a small pot had been noticed in the center of the back of the neck just below the hair margin. This lesion had gradually increased in size slowly at first apparently more rapidly within the past year. She now presented a raised slightly pendulous area of skin on the nape of the neck measuring  $2\frac{1}{4} \times 1\frac{3}{4}$  inches the long axis of which was parallel to the long axis of the vertebral column. The follicular openings in this area were enlarged but the hair was fine and sparse. The skin was lax the natural folds and rugæ enlarged giving rise to an uneven surface which was slightly more pigmented than the surrounding integument. The skin could not be drawn out farther than its redundancy permitted. The patient had no other skin abnormalities.

The patient's general health was good. The neurological examination revealed nothing abnormal and the patient had kept up with her classes at school. She was apparently of average mentality.

The lesion was removed under local anaesthesia by Dr. William Asbury Smith (now of Beaumont, Texas) and the wound healed resulting in a linear scar.

THE QUESTION OF GASTRO-ENTEROSTOMY IN DUODENAL ULCERS<sup>1</sup>

BY GEORGE WOOLSEY MD FACS NEW YORK CITY

FIVE years ago I read a paper on "The Results of Operation in Gastric and Duodenal Ulcers" (20). Since then a great amount has been written on the end results of gastro enterostomy. It has become the custom, if not the fashion to condemn the operation. This is not unusual but is what is to be expected as a natural swing of the pendulum, so often exemplified in the history of medicine. By this I do not mean to say that many have not had reason to criticize the operation and its results. We can understand this criticism especially when we remember that so much depends upon the proper selection of cases which means the exclusion of all in which an ulcer cannot be demonstrated upon a proper technique and upon careful after treatment.

At the time of my previous paper I found that in 91 per cent of my cases the late results were satisfactory. I have re examined these cases including only those operated upon 4 or more years ago looking up the more recent follow up reports and inquiring as to the present condition in other patients. I have been unable to get reports from nearly 25 per cent of the patients after they have left the hospital. These have to be eliminated though in my experience most of such patients if we do hear from them have no complaint to bring them back.

I have been able to follow 60 cases from 12 years to 3½ months the average of the follow up reports being 32 months. In 83.33 per cent the result was satisfactory. If we exclude 1 case in which a marked ptosis of the right kidney accounted for the present symptoms the result is satisfactory in 90 per cent. Of the other cases classed as failures 1 patient was well for 6 years and then had a recurrence of ulcer on the posterior surface of the duodenum the original ulcer being on the upper surface. The stoma was found contracted to the size of the finger. Another patient was well for 2 years when symptoms of duodenal ulcer recurred. Another had re-

currence of symptoms after 8½ months. The gastric acidity was normal and he was relieved by medical treatment. Another patient with psychic disturbances was reoperated upon 1 year after the first operation but nothing was found and the stoma was in good condition. In only 1 case was there evidence of jejunal ulcer. This patient operated upon 9 years ago had been well for 15 months or more after operation when symptoms returned. He re entered Bellevue Hospital a few weeks ago but left before an X ray examination was made to confirm the clinical diagnosis of jejunal ulcer.

Of the patients classed as improved who at times complain of abdominal symptoms none gives typical ulcer symptoms or symptoms similar to those before operation. About 50 per cent of them suffer from constipation and about 75 per cent have occasional symptoms somewhat suggestive of a gall bladder lesion that is epigastric fullness after eating and pain or distress partly relieved by the belching of gas. I have recently operated on one of these patients 8 years after the first operation. She was well for 2 years and then had symptoms diagnosed as gall stone colic. A chronic gall bladder with gall stones was found and removed. The ulcer was healed though the X ray showed a deformed cap from scar tissue. The gall bladder was removed only 4 times in this series at the time of the gastro enterostomy and only once for stones. The appendix was removed in 45 per cent of the cases or whenever there was evidence of inflammation. In 5 cases it could not be brought up into the wound for examination in 7 it appeared normal and in 20 it was not mentioned in the history. If there is any suspicion of chronic inflammation of the appendix or gall bladder removal is indicated.

All other foci of infection should be removed especially infected teeth and tonsils. For years I have been particular about the diet of the patients during their stay in the

hospital and for some months thereafter. By observing these precautions I think that the number of patients classed as well will increase at the expense of those classed as improved. On the whole I think that our results are satisfactory, though the percentage is a very little lower than it was 5 years ago.

When we examine the literature we find a number of surgeons especially German surgeons and those most influenced by German surgical literature, who, with a rather high mortality and indifferent results have abandoned gastro enterostomy and substituted gastrectomy, entailing a higher mortality to obtain better results.

It is difficult to explain the poor results obtained by many surgeons. There are a few simple principles that must be observed if good results are to be obtained from gastro enterostomy for duodenal ulcers.

1. It should never be done unless the ulcer can be seen or felt.

2. A few essentials in the technique are (a) The opening is made so that it lies at the most dependent part of the stomach (b) only absorbable sutures are used (c) the proximal loop of jejunum is made short but not taut, (d) all foci of infection intra abdominal and extra abdominal must be removed and careful diet instituted. With these simple rules the mortality should be low and the poor results and sequelae few. Of the sequelae jejunal or marginal ulcers have caused the most criticism of gastro enterostomy. Balfour (1) states that in 2 per cent of the large number of gastro enterostomies at the Mayo Clinic jejunal ulcer developed. Koennecke and Junge (10), report jejunal ulcer in 4 per cent of 520 cases. Lewisohn (11) states that it is generally assumed that jejunal ulcer follows in 5 per cent of cases. As Balfour (1) says, the symptoms of jejunal ulcer are easily recognized and the diagnosis is confirmed by the X ray in more than 95 per cent of cases. The pain is usually lower often to the left and as Lewisohn says it is more intense. A few jejunal ulcers occur later than the 2 year limit given by Sherren (19). Koennecke and Junge (10) in 22 cases found only 3 ulcer developing from 3 to 9 years later. The real cause is

unknown and they still occur when the contributing causes that we know are eliminated. In my small series it has occurred in less than 2 per cent of the cases we have been able to follow.

The discrepancy between 2 and 4 per cent from actual series of cases referred to above is not so great but that it may be explained by differences in technique and other factors. But in a recent paper by Lewisohn (11) he says that in 68 cases traced 4 to 9 years after gastro enterostomy for duodenal and pyloric ulcers jejunal ulcer was proved by operation in 18 per cent and diagnosed by the X ray together with clinical symptoms in 16 per cent a total of 34 per cent. These figures are to me inexplicable and so at variance with the general experience that it seems as if there must be some peculiar factors to account for them. Some may be explained by failure to follow the few simple rules I have laid down for gastro enterostomy, but that alone is hardly sufficient. Eusterman (6) finds that there is a tendency to recurrence of ulceration in the Hebrew, and in those with a highly irritable nervous system who smoke excessively. The intemperate use of tobacco alcohol and condiments hasty eating of bulky indigestible food soon after operation, also fatigue exposure and infection are predisposing causes. These factors may in part explain Lewisohn's experience as his report is from the Mt Sinai Hospital. Apparently Pagenstecher thread was used for the outer peritoneomuscular suture in most of Lewisohn's cases.

As Renton (17) has shown in 3 cases and in animal experiments the outer suture if unabsorbable tends to work its way into the lumen and be cast off, even when it has not penetrated the mucosa. In this process it is obviously a source of infection. This has been demonstrated by many other observers. In a study of jejunal ulcer Guillaume and Hara lamibidis (9) in discussing preventive measures emphasize avoiding local irritation, especially from sutures and hyperacidity and particularly keeping up medical treatment after operation.

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The von Eiselsberg exclusion method has been given up as it is followed by a high

percentage of jejunal ulcers (17 per cent von Haberer). However Lewisohn says that the Berg exclusion has not increased the percentage of jejunal ulcers. With our most careful efforts it must be admitted that in a small percentage of cases gastrojejunal ulcers do develop but this should not occur in over 2 or, at most, 4 per cent.

But there are other criticisms bearing on the problem of gastro-enterostomy. Hemorrhage is not entirely prevented if it has occurred previously. Balfour (2) found that in 13 per cent of such cases the ulcers will bleed again if they are not excised. He classes bleeding ulcers and small ulcers on the anterior wall as a group suitable for excision. Since in 87 per cent of bleeding ulcers no further hemorrhage occurs after gastro-enterostomy we may as Peck (16) says do a gastro-enterostomy as the first step if excision is not applicable in a given case. Hematemesis or melena occurred in 5.7 per cent after gastro-enterostomy in the 1000 cases reviewed by Balfour (3) from the Mayo Clinic, but the bleeding subsides on treatment especially if it was not present before operation. In many such cases the bleeding comes from the ulcer and not from the stoma. As Balfour (3) says serious hemorrhage from the anastomosis must be regarded as a technical blunder for which the surgeon assumes responsibility though Metge (13) reports 4 deaths from hemorrhage after gastro-enterostomy.

Although Balfour (3) states that protection against subsequent perforation is absolute since not a single case has occurred among these 1000 patients F. M. Douglas (5) reports 1 case 3 days after operation.

Lewisohn (11) thinks that gastric acidity is not altered by gastro-enterostomy. In my own cases which show the gastric analysis both before and after operation the acidity was reduced to below normal in 63 per cent and to normal in 27 per cent. These analyses were made from 1 month to 8 years after operation. Cushman (7) reports from the Mayo Clinic that the total and free acid was reduced from 40 to 60 per cent after gastro-enterostomy. In 85 cases showing the gastric analysis before and after operation,

Sherren (19) found 131 with no hydrochloric acid 63 in which it was greatly reduced 52 in which it was reduced to normal and only 37 in which it was not reduced. In the first group there was no return of symptoms in the second the end results were satisfactory in the third symptoms persisted in 5 only while in the fourth 17 had symptoms including all who had jejunal ulcer 5 in number.

In nearly every case of my series, when the postoperative acidity was above normal the result was unsatisfactory. This was true of the only case of jejunal ulcer, the total acid being 76 and the free hydrochloric acid 61 14 months after operation.

The importance of the reduction of hyperacidity is generally recognized and is well expressed by Balfour (3) who says 'The recurrence of ulcer after gastro-enterostomy or in fact after any type of operation is apparently directly associated with failure to reduce the acidity to maintain this reduction and to provide adequate drainage.' For this purpose the stoma should reach to the lowest point of the greater curvature.

The relation between hypo-acidity and freedom from ulcer is not invariable since well developed ulcers exist with achlorhydria. Several cases in my series showed a low or normal acidity before operation and one of these was unimproved. At least 5 of my cases which were only improved had a low postoperative acidity. A high preoperative acidity seems to be a favorable factor. Thus of those of this type 86.6 per cent were free of all symptoms after operation and only 6.6 per cent were unimproved.

In all these series of cases a large percentage of the patients with duodenal ulcer treated by gastro-enterostomy are entirely well. Others forming a smaller group have occasional abdominal symptoms not like those originally complained of which do not interfere with their work or their enjoyment of life. In the vast majority of such patients the ulcer has healed and the occasional symptoms of indigestion are functional or due to extra gastric causes. No operation can insure a patient against occasional indigestion.

These two groups those classed as well or improved comprise the satisfactory results

and represent from 80 to 95 per cent of the cases. Balfour (3) in 1000 cases operated on at the Mayo Clinic 10 or more years before found satisfactory results in 88 per cent. W. J. Mayo (12) says that gastro-enterostomy cures over 90 per cent of duodenal ulcers and Peck (16) in a recent article, states that 80 to 90 per cent of the patients were completely relieved of symptoms. Sherren (3) in 500 cases reports 92.6 per cent perfectly well, 2 or more years after gastro-enterostomy. Not all continental surgeons report unsatisfactory results. Galpern (8) says that in duodenal ulcer gastro-enterostomy gave 78.2 per cent of excellent results and 19 per cent of bad results. Schwyzer (18) found that gastro-enterostomy gave relief in 80 per cent for 4 years. Later the number was reduced to 75 per cent.

The small percentage of unfavorable results include the few jejunal ulcers and recurrent ulcers in the duodenum or stomach. Such recurrent ulcers, whether jejunal, duodenal or gastric, form a small group suitable for gastrectomy.

Most of the failures in Balfour's (3) series were in the 129 cases in which the appendix was not removed. Eusterman (7) says that in from 13 to 18 per cent of all cases of chronic ulcer there is associated gross disease of the gall bladder. I agree with Blackford and Dwyer (4) that if the careful internist says that the gall bladder should be removed on the clinical and physical evidence, the surgeon must seriously consider his responsibility in saying that the gall bladder appears normal and in leaving it alone. The difficulty lies in diagnosing from symptoms alone a slightly diseased gall bladder without stones when the picture is obscured by the symptoms of ulcer.

But there will still be a very few patients in every hundred operated upon who complain of vague symptoms, often functional in origin, frequently associated with constipation, who sometimes are neurotic or mentally disturbed, whose treatment should be medical and dietary and not surgical.

What are the alternatives to gastro-enterostomy for duodenal ulcer? The three following will be briefly considered.

1 *Medical treatment* The majority of patients that come to the surgeon have had one or more courses of medical treatment with relapse. Nielson (15) re-examined 239 patients after they had been treated medically  $2\frac{1}{2}$  to 19 years. In 95 to 98 per cent of the cases the patients were discharged symptom free but 700, 83.7 per cent, were not permanently cured. The longer the duration of the ulcer the larger the percentage of recurrences. If we take into account the results of hemorrhage and perforation, medical treatment has a higher mortality than surgical treatment, as Moynihan (14) says in his Hunterian lecture. The mortality of gastro-enterostomy is about 2 per cent. Moynihan had 500 consecutive cases without a death.

2 *Excision or pyloroplasty* Excision is applicable to some bleeding ulcers and to recent single small ulcers on the anterior wall of the duodenum without scar formation or stenosis but this includes only a small group. Ulcers giving repeated hemorrhage are better treated by excision if this is technically applicable. In suitable cases it gives satisfactory results and may be combined with pyloroplasty or gastro-enterostomy. Balfour (3) states that even in small recent ulcers, experience in the Mayo Clinic shows that excision with or without pyloroplasty gives no better end results than gastro-enterostomy.

Pyloroplasty affords the opportunity to excise the ulcer in a moderate percentage of cases. It does not prevent the reformation of ulcers. Thus Horsley (3) observed recurrence along the suture line in nearly 10 per cent of cases. Eusterman (7) states that experience with several hundred pyloroplasties has not been encouraging and that at least 15 per cent of pyloroplasties are later subjected to gastro-enterostomy with good results. An advantage of gastro-enterostomy lies in the fact that it is non-destructive and can be undone.

3 *Gastrectomy* This is a more serious operation and gives a mortality at least two and a half times as great as gastro-enterostomy, that is 5 per cent (von Haberer) against 2 per cent or less. Lewisohn (11) gives the mortality as 5 to 10 per cent. That

it does not insure against recurrence is evidenced by Finsterer's (3) report of 6 cases in which ulcer occurred after partial gastrectomy

The achlorhydria produced is not always without bad effects. According to Balfour (3) patients with achlorhydria frequently present a definite syndrome of gastric symptoms which may be more disabling than those for which the gastrectomy was performed.

There is however a small but definite group in which partial gastrectomy is indicated. This includes those duodenal ulcers which cause severe hæmorrhage in which gastroenterostomy may fail to relieve the symptoms and pyloroplasty or excision cannot well be applied also those with recurrence of ulcer locally or at the stoma.

The recurrence of ulcer in 3.5 to 5 per cent of cases after gastroenterostomy does not justify gastrectomy in 100 per cent when the mortality of the latter is two or three times as great. I agree with Charles Mayo who in the discussion of Balfour's paper (3) said that he would not allow anyone to remove half of his normal stomach to cure a duodenal ulcer.

#### CONCLUSIONS

**Late results.** Many series of cases of duodenal ulcer treated by gastroenterostomy by American and British surgeons give satisfactory results ranging from 80 to 95 per cent. My own series shows 90 per cent. Jejunal ulcer follows gastroenterostomy in about 2 per cent of cases. In many cases improved (not cured) by the operation the ulcer is healed and the symptoms present are due to extragastric causes commonly the appendix or the gall bladder. Bleeding occurs in only a small percentage (5.7 per cent) after gastroenterostomy and as a rule this hæmorrhage is not serious. Gastric acidity is much reduced

by gastroenterostomy and remains so. This is essential to the best results.

A few simple rules must be followed to obtain good results: (a) A gastroenterostomy should be done only when the ulcer can be seen or felt. (b) A good sized opening at the lowest point of the stomach should be made. (c) Only absorbable sutures should be used. (d) Extra gastric causes of gastric symptoms and all foci of infection must be removed. (e) The after treatment and diet must be as strict as that used in the medical treatment of ulcer.

Excision is applicable in a small group of cases with or without gastroenterostomy. Pyloroplasty is a good operation but the results are inferior to those of gastroenterostomy. Gastrectomy has a much higher mortality and is not justifiable as a routine to avoid the small percentage of recurrence. It is applicable in a small group to cure recurrent hæmorrhage or ulceration jejunal duodenal or gastric.

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## FRACTURE OF BOTH BONES OF THE FOREARM

## STUDY OF TWO HUNDRED CASES

By CECIL H. BAGLEY, M.D., BALTIMORE, MARYLAND  
 From the Surg. Clinic of the Johns Hopkins Hospital and Medical School

THE trend of practice at the present time is to reduce fractures by open operation only when it is impossible to obtain fairly satisfactory position by the closed method. There are cases however in which lack of co-operation on the part of the patient or absence of operating facilities cause the surgeon to be content with a partial reduction. It was this type of case that prompted a review of 200 fractures of both bones of the forearm treated in this clinic. The results of the study show that greater liberties can be taken if the fracture occurs before the bone growth has been completed as will be seen in the cases reported.

There is much discussion in the literature concerning the open and closed methods of treating fractures. At a meeting in Glasgow in 1922 Young (3) remarked: "We want very much to get away from the attitude of being readily satisfied with anything short of the best attainable." Apparently indicating operation as the only method by which such a standard can be maintained he stated that it is the failure to adopt even yet in some surgical clinics the open operative method as almost a routine procedure that must bear the larger part of the reproach that still remains in the sphere of fracture treatment.

As opposed to this idea Dowden (3) of Edinburgh stated that he had obtained good results by reducing the fractures as well as possible without operation that the perfect anatomical adjustment of the fragments was not necessary but that early active and passive motion of the extremity involved was very important. In some cases he did not even splint the fracture but placed it in a sling. He emphasized this method of treatment by saying active movements should follow on the heels of pain. The above points of view diametrically opposed as they are indicate the lack of uniformity in our methods of handling these fractures. One surgeon is

content only with a perfect anatomical and functional result while a second places function first, and deformity as a secondary consideration. It is the purpose of this study to determine which of these two conflicting viewpoints is the sounder. It may well be that neither is entirely correct nor on the other hand entirely wrong and there is possibly a middle ground that may be followed to the best advantage.

A brief review of the anatomy of the forearm is essential to a clear understanding of the fractures which occur in this region since the position assumed by the fragments is constant at the different levels depending upon the particular structures involved at the site of injury.

The shafts of the radius and ulna first appear in the second month of fetal life. The olecranon appears in the tenth year and fuses with the shaft in the sixteenth year. The lower epiphysis is first found (by X ray) in the sixth year and fuses in the twentieth. The ulna forms the articulation of the forearm with the humerus its lower end playing an almost negligible part in movements at the wrist. Just the reverse condition holds true for the radius in that its lower end plays the leading rôle in the movements of the wrist whereas its upper end serves only in a minor capacity at the elbow joint. In supination the bones of the forearm lie parallel whereas in pronation the radius is rotated about the ulna and crosses it at about its middle third.

If the origin, insertion and action of the muscles of the forearm are considered in the reduction and fixation of these fractures the task is frequently simplified and a better result obtained. This phase of the anatomy of the forearm is important (Fig. 1).

The brachioradialis muscle arises from the lower end of the humerus and is inserted into the lower end of the radius. It assists in flexing the forearm and is also a semi pro-

nator and semi supinator, bringing the fore arm from the supine or prone position to one in which the radius is uppermost. Therefore the maximum relaxation of the muscle is obtained when the elbow is flexed and the hand midway between supination and pronation the usual position for splinting a fracture of the forearm. As practically all the extensor muscles of the hand and fingers arise from the lower end of the humerus they cause little pull on the fragments but aid in splinting the radius and ulna posteriorly when under tension, as when the elbow is flexed.

The supinator muscle arises from the lower end of the humerus laterally and the upper end of the ulna and passes distally and medially to be inserted into the upper third of the radius. Thus a fracture between the upper and middle thirds of the radius would have the upper fragment supinated and the lower fragment pronated by the pronator teres muscle. This muscle arises from the lower end of the humerus medially and the coronoid process of the ulna and is inserted into the middle third of the radius. The action and position of these opposing muscles in pronation and supination is shown in Figure 1.

The more powerful flexor muscles of the forearm have a tendency to produce dorsal bowing of the radius and ulna during healing as their pull is not counteracted by the weaker extensor muscles on the dorsum.

With these essential anatomical facts in mind we can now proceed to a consideration of the points brought out by a study of the 200 cases in which both bones of the forearm were fractured. These have been grouped together in Table I.

In considering the age of the patient at the time of fracture it was noted that the vast majority of fractures of both bones of the forearm occurred before the age of 15 only 24 of the patients in this series being older. It is extremely interesting to note that 110 patients were less than 10 years of age.

In 183 cases the fracture sustained was the result of force applied indirectly, that is the injury was usually the result of a fall on the outstretched hand. Bearing this in mind we can

TABLE I—STATISTICAL STUDY OF TWO HUNDRED CASES

Age	Case
0 to 10 years	110
11 to 15 years	66
Over 15 years	24
<b>Etiology</b>	
Direct violence	17
Indirect violence	183
<b>Site of fracture</b>	
Upper third	16
Middle third	79
Lower third	101
Epiphyseal separation	4
<b>Variety of fracture</b>	
Complete	94
Greenstick	96
Compound	10
<b>Injury</b>	
To bone	200
To soft parts	17
<b>Reduction</b>	
Closed—good	172
Closed—fair	13
Open operation	15
<b>Results</b>	
Satisfactory	194
Unsatisfactory	6

conceive that the natural bowing of the bones to be described may determine in a measure the location of the fracture. The remaining 17 cases were the result of force applied directly such as blows crushing injuries gun shot wounds etc.

The idea seems prevalent that following indirect injury in children epiphyseal separation is to be expected rather than fracture of the lower end of the radius and ulna (Baetjer and Waters 1). Such a point of view finds no support in the present study since in the 200 cases included epiphyseal separation occurred in only 4 instances (approximately 2 per cent). This would seem to indicate that the epiphysis is not the weakest point as is commonly supposed but that as a result of indirect violence such as falling on the outstretched hand fracture is to be expected rather than epiphyseal separation. The explanation of this observation may lie in the following facts: (1) There is little or no strain or leverage exerted on the epiphysis by indirect trauma (2) the epiphysis is protected to a very great degree by the tough capsule of the neighboring joint, (3) the elasticity of the epiphysis,

with its cartilaginous attachment is much greater than that of the diaphysis

The radius and ulna were divided into thirds and it was found that 101 fractures occurred in the lower third, 79 in the middle and 16 in the upper third. The reason for this distribution is not immediately apparent. Is it because these bones are sturdier in the proximal third than in the distal two thirds or is it perhaps because the upper portion of the bones is better protected by the muscles of the forearm? One or both of these reasons may be applicable. It is certainly true that the proximal portion of these bones is thicker and larger since at this site the muscles of the forearm have their origin and the muscles of the upper arm their insertion. In addition to the above mentioned factors which may aid in the prevention of fractures in the upper portion there is a natural bowing which may account for the predominance of fractures in their distal portion.

Within the brief scope of this paper it was not deemed essential to enter into any detailed classification hence the series was divided simply into complete incomplete or greenstick and compound fractures. Ninety-four of our cases were of the first variety, 96 of the second and 10 of the last. It is usually stated that in children the predominant type of fracture is the greenstick variety. To explain this idea it has been held that the bones of children are soft and hence more elastic and for this reason are more liable to bend than break. Such would seem to be logical reasoning though it is interesting to note that in this series incomplete fractures occurred almost as frequently in children as complete ones there being 96 of the former and 80 of the latter.

In simple fractures the soft parts were rarely injured seriously. Occasionally however a small hematoma developed over the site of fracture but in every case was promptly absorbed. Nerve injury was never present in the simple cases. In those cases resulting from direct violence all varieties and degrees of injury to the soft parts were found making amputation necessary in a few instances.

In fractures of the forearm as elsewhere the necessity for prompt reduction is obvious.

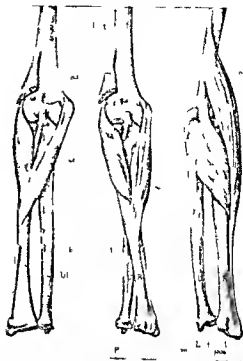


Fig. 1. Illustrating that particular part of the anatomy of the forearm most frequently fractured.

Gould (4) says: Reduction of the fragments should be complete or perfect at once; we should not rest in any half-way house content with an improvement today with the hopes of still greater correction tomorrow. In all reductions of the forearm three aims should be kept in mind: (1) as rapid firm bony union as possible; (2) as complete anatomical correction of fragments as possible; (3) as early active and passive motion as possible. It is not always advisable to subject the patient to repeated reductions in order to obtain a perfect position of the fragments because an extremity which has been immobilized for a great length of time or which has been subjected to repeated manipulations is likely to have impaired function for a considerable length of time afterward. One might infer from this that good function is better than a condition which the X-ray plate shows as anatomically perfect.

Whenever possible a closed reduction was done there being 190 cases in this series, the other 10 being treated by open operation. In dealing with fractures traction seems to be



the secret of success. Frequently under the fluoroscope if traction alone were made on the hand and counter traction maintained on the humerus the fragment slipped into place without manipulation. Eighteen cases were incompletely reduced but the surgeon in charge decided to be content with the reduction obtained without operative interference. That this decision was well justified is indicated by recent examination after complete healing.

Open reduction was resorted to only when the closed method had failed that is in those cases with marked overriding when excess callus from poor reduction would interfere with function or would injure nerve or blood supply and in adults when there was little or no tendency toward spontaneous correction of deformity. In many instances we have been satisfied to leave the fragments in the position resulting from reduction by the closed method although the reduction was not anatomically perfect. We pursued this course (and this is one of the points we have desired to stress in this study) believing that the ultimate result thus secured would be far more favorable from the point of view of function than the perfect anatomical alignment secured by open reduction. Fixation was secured in 5 cases by the use of silver wire in 3 by plates while in 2 no internal splinting was necessary. In the rather small series of cases in which the open reduction was used subsequent removal of the material used in fixation was necessary for the relief of pain in several instances.

At the time of reduction radiographic examination showed good or excellent alignment in 172 cases in 18 cases the reduction was only fair while in the remaining 10 a sufficiently good position could be obtained only by open operation.

The following observation was made during the course of study which may in a measure explain the correction of deformity which occurs subsequently to incomplete reduction in young persons. It was noted that when bowing occurred callus was laid down on the concave side of the deformity, there being little or no callus on the convex side save when the periosteum was raised from the bone

by the displacement of the fragments. This occurred with a striking degree of regularity in the series studied and is well demonstrated in Figure 4. Here it may readily be seen as for example in the ulna that there is a heavy dense callus extending over a distance of 7.5 centimeters on the concave side whereas on the convex side the new bone formation has less depth and less density and extends only for a distance of about 2 centimeters. The radius likewise demonstrated the same point strikingly illustrated in Figure 5.

Many explanations have been offered to account for the formation of callus at the site of fracture. Whether new bone arises from the cortex or from the periosteum is still a question of doubt some observers adhering to the former view others holding the latter to be more plausible. It is not our purpose to attempt to determine which of these two views is correct but to put forth what seems a reasonable explanation for the greater amount of callus formation found on the concave side of the bone. This we believe is due to the fact that on the concave side there is a relaxation of the periosteum and soft parts which permits hemorrhage and clot formation whereas on the convex side the periosteum is stretched and more adherent offering greater resistance to hemorrhage beneath the periosteum and into surrounding structures. Granting that hemorrhage takes place as described the various stages concerned in the repair borne out by the experiments of Bancroft ( ) are as follows.

Immediately after hemorrhage fibrin for matation and contraction of the clot occurs. This is followed by an ingrowth of connective tissue and a rushing in of small blood vessels. Following the penetration of blood vessels two distinct and opposite processes begin the rebuilding with live bone and the absorption of injured bone—the one task assigned by some observers to osteoblasts the other attributed to osteoclasts.

The ultimate result as determined by follow up studies of the group of cases seen during periods of from 1 to 10 years shows that 194 have a good result that is in 194 cases there is no apparent deformity or loss

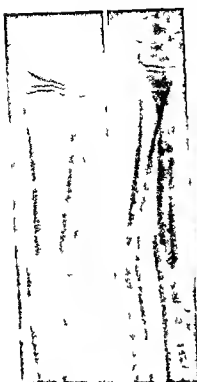


Fig 2

Fig 3



Fig 4



Fig 5



Fig 6



Fig 7

Fig 2 Fragments after final reduction (Case 1)

Fig 3 Same patient as in Figure 2 lateral view (Case 1)

Fig 4 Six weeks after the accident showing callous formation on the concave side of the deformity (Case 1)

Fig 5 Same patient as in Figure 4 lateral view (Case 1)

Fig 6 Appearance of the radius and ulna 20 months after the injury (Case 1)

Fig 7 Same patient as in Figure 6 lateral view (Case 1)

of function demonstrable. In 6 patients the end results were unsatisfactory in that there was present some deformity and loss of function due to arthritis and excess callus formation. Of these 6 unsatisfactory cases 4 were those of patients on whom an open reduction was performed. The remaining 2 and these were adults fall in the group in which reduction was only fair. It is noteworthy however that in the 18 cases in which actual reduction was only fair unsatisfactory end results occurred in only 2 instances and these 2 cases occurred in adults with completed bone growth.

These results we believe justify our point of view namely that in the reduction of fractures of both bones of the forearm in children an imperfect reduction is preferable to an open operation. In order to bring out this point more clearly the study of 3 cases is given in detail.

CASE 1. C. B., a male 12 years of age suffered a fracture of the radius and ulna August 22, 1921. Several attempts were made to reduce the fracture by the closed method. There was some improvement after each manipulation but considerable displacement persisted as seen in Figures 2 and 3. These roentgenograms were taken after the final reduction. In the opinion of the radiographer an open reduction was called for because of the apparent close approximation of the lower fragments with the arm in complete supination. However the lateral view, Figure 3, taken at the same time showed that there was a sufficient separation of these fragments to prevent ankylosis.

On the basis of this evidence the surgeon in charge decided to be content with the reduction obtained without operative interference. That this decision was justified is well indicated by the subsequent course of the case.

The patient's arm was kept in anterior and posterior plaster splints for a period of 6 weeks. The splints were removed at frequent intervals for massage and passive motion after the tenth day. Roentgenograms taken 6 weeks after the accident (Figs. 4 and 5) indicate a satisfactory improvement.



Fig 8

Fig 8 Position of fragments after final reduction (Case 2)



Fig 9

Fig 9 The same arm lateral view (Case 2)

both in the contour of the arm which is almost without deformity and in the general alignment of the fractured bones. Bony union is gradually taking place. There is considerable callous formation the bulk of which is on the concave side of the bones the jagged protruding ends have been absorbed. The patient uses the arm without hesitancy. All the movements are normal.

He was kept under observation and roentgenograms were made occasionally the final plates represented in Figures 6 and 7 having been taken in March 1923 about 18 months after the injury.

In Figure 6 it is scarcely possible to see the position of the break. There is a slight general bowing of the bones but the marrow cavity has been entirely re-established the cortex is not appreciably thickened the distance between the two bones at the site of the previous fracture is approximately normal. Figure 7 represents the lateral view showing practically the same changes. Examination of the arm at this time shows it to be perfectly straight and functioning well without pain or discomfort.

CASE 2. A U. a male age 13 years fractured the radius and ulna on November 13 1919.

Reduction was done under general anaesthesia but good alignment was not obtained as shown in

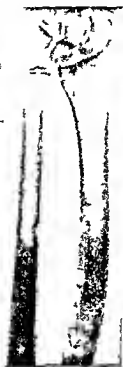


Fig 10

Fig 10 Appearance of radius and ulna 3 years and 10 months after the injury (Case 2)



Fig 11

Fig 11 The same arm lateral view (Case 2)

Figures 8 and 9. There is even considerable overriding of the ulnar fragments as noted in Figure 8 with anterior displacement of the lower end of the ulna as noted in Figure 9. As this patient came within the first group namely those in which the fracture occurred before the completion of bony growth and also as the main deformity was in the lower end of the ulna the surgeon prophesied a good result. The fracture was maintained in anterior and posterior plaster splints for 4 weeks these splints being removed at frequent intervals for massage and passive motion after the tenth day.

When the patient was discharged 6 weeks after the injury the arm was straight and the movements about the wrist joint were well performed and painless. He was asked to return to the hospital August 28 1923 for observation. Figures 10 and 11 represent the roentgenograms taken at that time. Examination showed the arm to be without deformity all the functions well performed and painless.

One is unable to find any evidence of the fracture in Figure 10. The marrow cavity is entirely re-established there is no thickening or irregularity of either the cortex or the periosteum. The overriding of the lower end of the ulna which was noted in Figure 8 seems to have been entirely compensated



Fig 12



Fig 13

Fig 12 Position of radius and ulna 6 weeks after the accident in adult 60 years of age (Case 3)

Fig 13 The same arm lateral view (Case 3)

for Figure 12 the lateral view taken at this time is also negative for any previous injury

CASE 3 is representative of cases in which the fracture occurred after the completion of bony growth

E. H. a female 60 years of age fractured the radius and ulna in 1919

Reduction was effected under general anesthesia but only a fair result was obtained as indicated in Figures 12 and 13 which roentgenograms were taken 6 weeks after the accident. The patient was discharged at this time complaining of some pain in the wrist but very little actual deformity. She was kept under observation until September 10 1923. During this time there was practically no improvement in the deformity at the wrist. The pain on motion persisted and was more severe in bad weather.

At the last observation September 10 1923 the original deformity was about the same. She complained of painful motion about the wrist of limitation of function and deformity. There was some atrophy of the muscles of the hand signifying non use. Figures 14 and 15 represent the condition of the bones 5 years after the accident. In Figure 14 we see the same general deformity of the lower end of the radius and ulna as in Figures 12 and 13 taken 4 years previously. The periosteum and cortex of

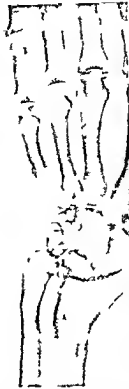


Fig 14



Fig 15

Fig 14 Position of radius and ulna 3 years and 11 months after the accident (Case 3)

Fig 15 The same arm lateral view (Case 3)

the bone is slightly thickened. There is some arthritis of the wrist joint.

Comparing this case with the previous one both fractures being in the same location and of the same type we see marked difference in the subsequent course of a fracture that has not been perfectly reduced in a child and one similarly treated in an adult.

#### CONCLUSIONS

A study of 200 cases 176 patients being under the age of 15 years has been made to determine the end results of imperfect anatomical reduction of fracture of the forearm.

1. In children a good result may be expected even when a perfect reduction has not been obtained since there is much subsequent improvement as the bone growth proceeds.

2. In children complete fracture is more frequent than the greenstick variety when both bones of the forearm are involved.

3 In adults there is a very little tendency to overcome deformity following imperfect reduction

4 Following indirect injury or trauma fracture of both bones is to be expected rather than epiphyseal separation

5 When both bones of the forearm are fractured, the fracture occurs in the lower two thirds in 90 per cent of the cases

6 Before bony growth is complete a closed reduction is preferable to an open one even

though perfect alignment of the fragments cannot be obtained

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## RUPTURED CORNUAL PREGNANCY

### DISCUSSION OF CORNUAL PREGNANCY AND THE LITERATURE

By JOHN L CROVE M D NEWTON KANSAS

**E**XTRA-UTERINE or ectopic pregnancy is a condition of rather infrequent occurrence however during the past decade there has been reported a constantly increasing number of cases of tubal pregnancy as compared with normal gestation. The percentage in 1900 according to different authorities varied from 1 case in 500 to 1 in 1200 pregnancies. The various statistics in recent years seem to indicate that the proportion is perhaps 1 to 250. One writer (8) reports 303 cases in a series of 688

patients (13 per cent). This increase in percentage might be explained first by our improved methods of diagnosis and secondly by the fact that more cases receive surgical treatment and are thereby more accurately diagnosed. Then too the more common use of hospitals and hospital facilities with the increased number of cases reported in this decade may have some bearing.

De Lee states that extra uterine pregnancy is considerably more frequent in city than in country practice (9). The explanation be



FIG 1 A Fundus of uterus B Cervix at point of amputation C Left cornu D Line of separation of broad ligament E Cornu elevated above fundus and containing fetus F The point of the rupture G The fimbria of right tube



FIG 2 Section through the body A—1 Left cornu B—B Outline of uterine cavity C—C Cervix D—D Right cornu E—E Fetus F—F Place of blood clots G—G Hypertrophied cornual muscular wall H—H Fallopian tube

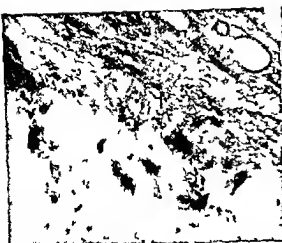


Fig 3 Photomicrograph showing section through placenta and uterine wall cornual region. Increased connective tissue and blood supply

Fig 4 Photomicrograph showing section through embryo uterine wall and placenta illustrating the embryonic structure

offers is that the diagnostic possibilities are better in the city and the general hospitalization of city patients is more universal. Might not the greater prevalence of gonorrhoea in the populous centers furnish a rational explanation of the larger number of ectopic cases in the city rather than the less acute diagnostic sense of the physician in country practice? If the experience of other clinics coincides with ours I am sure gonorrhoea should be considered as the ranking etiological factor in ectopic pregnancy. In 8 consecutive cases diagnosed as ectopic gestation in our clinic during the past 3 years 7 were operated upon. In the 1 case in which operation was not performed the vaginal discharge was positive for gonococci. In 5 of the 7 cases the gonococcus was demonstrated in the laboratory findings or the husband gave a history of recent active gonorrhoea. In the other 2 cases the husband of 1 patient reported gonococcal infection 2 years previously, the second husband denied gonorrhoea but the wife reported definite childbirth infection.

#### INTERSTITIAL OR CORNUAL PREGNANCY

The relative frequency with which interstitial or cornual pregnancy occurs as compared with the other types ampullar or isthmal might be tentatively estimated by considering the statistics of several different

writers. In 77 cases observed by Martin the following distribution is shown: ampullar type in 48 cases, isthmal in 8, cornual in 1; the balance are of the tubal, ovarian, tubal abdominal and undetermined types (6). In a series of 106 cases Oastler (7) found the isthmal type in 38 cases, ampullar in 32, cornual in 2, and in all others the type was undetermined. In 117 cases Foskett (4) found the ampullar in 52, the isthmal in 64, and the cornual in 1. In a paper by C. Daniel (2), he reports that Waegeli had up to the year 1915 collected only 50 cases of cornual pregnancy and in his paper he reports in his own experience only 2 cases. Di Palma (3) in his paper in 1920 reports only 2 cases that have come under his observation. Palmer in 1890 assembled 36 cases of pregnancy in the uterine horn including 12 by Kussmaul and added 2 new cases of his own. Conrad (1) added 11 cases from the literature up to 1923. In his paper he describes 1 case that came under his own personal observation. He is inclined to class all these cases as pregnancy of an accessory rudimentary horn. He states that in his cited case there was no communicating cavity from the accessory horn to the uterine cavity.

In our case there is ample evidence that the impregnated cornu is not an accessory horn as the communication from both the uterine

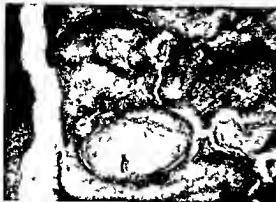


Fig. 5 Section through embryo showing decidual cells and embryonic tissue



Fig. 6 Section through the placental and embryonic tissues

cavity and the tube could be easily traced. Katz gives some interesting statistics taken from postmortem records extending over the period from 1899 to 1921 in which there was a series of 32 deaths caused by ruptured ectopic pregnancies. Of these 23 were isthmal, 5 ampullar, and 4 interstitial or cornual. From the above it is clearly evident that the condition of cornual pregnancy is of rather infrequent occurrence.

#### DIFFERENTIAL DIAGNOSIS

Cornual pregnancy may never be differentiated pre-operatively from isthmal and ampullar, but the continued closer scrutiny of the histories and the more accurate interpretation of our physical findings may at last give us the occasional reward of a proper diagnosis.

The asymmetry of the fundus known as the Ruge-Simmons sign in our case was only distinguishable after the abdomen was open but on pre-operative bimanual examination it gave one the impression of a fixed tubal mass close to the uterine horn, solid enough to suggest a fibroid. This will be suggestive if encountered again with the syndrome of tubal pregnancy. The absence of any fixed mass in the opposite adnexa and the lack of cul-de-sac masses were noted in our cited case. While these do not preclude the diagnosis of ordinary pus tubes, they should also have been suggestive.

The findings on bimanual examination of

an enlarged fundus with an asymmetrical mass making its displacement forward and not toward the cul-de-sac should always suggest a cornual ectopic condition.

#### CASE HISTORY

Our patient is 28 years of age, has been married 8 years and has 1 child 7 years of age. Her entry to the Axtell Hospital was on March 25, 1924.

**History.** Patient's parents were both living and in good health, two brothers and one sister living and well, no brothers or sisters dead. Her past history showed that the patient was operated upon for acute appendicitis 6 years previously. There was no history of any miscarriages. The patient believed she had had some pelvic infection, probably gonorrheal, originating about 2 years before and persisting in subacute form up to the present time. This infection had been so severe at times that the patient had gone to bed with fever and pelvic pains. Her menstrual history up to 2 years ago was normal, not painful and fairly regular. For the past 2 years the periods had been more painful and inclined to more irregularity. The January period was normal and on time. The February period was passed and patient consulted a physician for this condition and I presume received the usual placebo. She stated that early in March she flowed a few days, then the period stopped and again after a few days she had a considerable amount of discharge with only slight bloody show. This discharge had entirely ceased on the day prior to her entry to the hospital, which was the first day she experienced acute symptoms. On Monday, the day prior to her hospital entry at 11:00 a.m. while going about her ordinary household duties, she fell over in an unconscious spell which lasted several hours. This spell was attended with very severe pain over the abdomen and all evidence of shock and hemorrhage. She was seen by her local physician who recognized the condition

as a possible ruptured ectopic pregnancy. He prescribed quiet cold packs and remedies to combat the shock. On the next day the patient had some what recovered but was having periodic attacks of h. d. p. in which if attended with the least exertion caused fainting spells. She entered the hospital on the afternoon of that day with the following condition and physical findings:

**Physical findings.** The patient was a poorly nourished thin individual markedly under the effect of opiates. She had had four quarter grams of morphine in the past 12 hours. There was a medium degree of pallor, no sighing respiration or evidence of presence of shock as reported in her history. The pulse was 100, axillary temperature 99.8. The chest was normal, abdomen much distended, apparently full of gas. There was much rigidity over the entire abdomen with no especial tender point. Bimanual examination showed the uterus slightly fixed and enlarged, no palpable masses could be determined either in the cul-de-sac or in the adnexa. The pelvic examination was unsatisfactory on account of the distention. The size of the uterus could not be accurately determined and the cervix had a soft feel. There was a free pus discharge from the cervix of thick creamy character with very little odor. There was no blood in the discharge.

**Laboratory findings.** Hemoglobin 63, per cent red blood cells 3,000,000, leucocytes 25,400 differential count indicated polymorphonuclear leucocytes predominating, blood pressure was 126/72, urine normal. Examination of the vaginal discharge revealed the presence of gonococcal infection.

**Diagnosis.** A tentative diagnosis was made of pelvic infection with peritonitis, first ruptured tubal pregnancy, second.

**Conduct of case.** The patient was put in the charge of a special nurse with instructions to follow the pulse and report accurately on the general condition. During the afternoon the patient suffered one fainting spell at which time the pulse reached 100 but remained of good quality. The temperature in the evening reached 100.6. On the second day the patient seemed improved, a repeated vaginal examination gave the same findings as previously recorded. At times there was some slight bloody discharge from the uterus, never any bulging in the cul-de-sac.

The only treatment employed was cold packs to the abdomen and sterile hot douches once daily and enemas for gas. The progress of the patient during the next 12 days was one of gradual improvement. For 3 days prior to the operation the temperature had remained normal and the pulse had followed a range from 84 to 90. The abdomen had become considerably less rigid and was not painful on palpation. Bimanual examination showed the uterus fixed with a more prominent firm mass in the right side of the pelvis, closely attached to the fundus uteri and the cervix was more firm than on

first examination. There had been an occasional slight bloody discharge and a considerable lessening of the purulent discharge. The blood examination showed 14,000 leucocytes and a slight increase in red cells. The blood pressure was 115/70. The patient was feeling very much better and demurred somewhat on accepting surgical treatment. The operation was performed April 7 under ether anesthesia.

**Operative findings.** A median incision was made. The peritoneum was considerably discolored giving evidence of hemorrhage in the abdominal cavity. Quite dense lines of omental adhesions were found along the site of the previous operation which had been a right median incision. After these and the newer recent adhesions were loosened, a large quantity of clotted blood was removed. Great care was taken not to severely traumatize the coils of intestine which had been sealed together and to the uterus with the clotted defibrinated blood. Probably a pint of blood serum was sponged from the abdomen. After the adhesions were freed the tubes were carefully visualized and it was noted that there was a rupture of the right tube at the cornu of the uterus from which there was some oozing of bright blood. The procedure determined upon was a subtotal hysterectomy. This was done in the usual manner. The left adnexa which was apparently normal was left in place. A glass drainage tube from the cul-de-sac was used and the usual closure made. The time consumed in the operation was 45 minutes. The period of her recovery was uneventful and she was dismissed from the hospital in 18 days.

**Examination of specimen removed (Fig. 1).** The gross specimen as photographed shows the uterine body slightly larger than normal and of firm consistency. On the left the fundus is of normal shape and none of the adnexa is attached. On the right side there is a mass about the size of a small lemon bulging out from the fundus. On the posterior surface the peritoneal coat is smooth and unbroken. On the anterior surface there is a roughened condition of the peritoneal coat evidencing adhesions and at a point on the anterior wall there is also evidence of the source of rupture. The right horn where the mass appears is considerably higher than the cornual region on the left. The mass is of about the same consistency as the fundus of the uterus. The tube on the right side is attached.

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Fig 5 Section through embryo showing decidual cells and embryonic tissue



Fig 6 Section through the placental and embryonic tissues

cavity and the tube could be easily traced. Katz gives some interesting statistics taken from postmortem records extending over the period from 1899 to 1922 in which there was a series of 32 deaths caused by ruptured ectopic pregnancies. Of these 23 were isthmal, 5 ampullar and 4 interstitial or cornual. From the above it is clearly evident that the condition of cornual pregnancy is of rather infrequent occurrence.

#### DIFFERENTIAL DIAGNOSIS

Cornual pregnancy may never be differentiated pre-operatively from isthmal and ampullar but the continued closer scrutiny of the histories and the more accurate interpretation of our physical findings may at least give us the occasional reward of a 'par' diagnosis.

The asymmetry of the fundus known as the Ruge Simmons sign in our case was only distinguishable after the abdomen was open, but on pre-operative bimanual examination it gave one the impression of a fixed tubal mass close to the uterine horn, solid enough to suggest a fibroid. This will be suggestive if encountered again with the syndrome of tubal pregnancy. The absence of any fixed mass in the opposite adnexa and the lack of cul de sac masses were noted in our cited case. While these did not preclude the diagnosis of ordinary pus tubes they should also have been suggestive.

The findings on bimanual examination of

an enlarged fundus with an asymmetrical mass making its displacement forward and not toward the cul de sac should always suggest a cornual ectopic condition.

#### CASE HISTORY

Our patient is 28 years of age, has been married 8 years and has 1 child 7 years of age. Her entry to the Axtell Hospital was on March 25, 1924.

**History.** Patient's parents were both living and in good health, two brothers and one sister living and well, no brothers or sisters dead. Her past history showed that the patient was operated upon for acute appendicitis 6 years previously. There was no history of any miscarriages. The patient believed she had had some pelvic infection, probably gonorrheal, originating about 2 years before and persisting in subacute form up to the present time. This infection had been so severe at times that the patient had gone to bed with fever and pelvic pains. Her menstrual history up to 2 years ago was normal, not painful and fairly regular. For the past 2 years the periods had been more painful and inclined to more irregularity. The January period was normal and on time. The February period was passed and patient consulted a physician for this condition and I presume received the usual placebo. She stated that early in March she flowed a few days then the period stopped and again after a few days she had a considerable amount of discharge with only slight bloody show. This discharge had entirely ceased on the day prior to her entry to the hospital which was the first day she experienced acute symptoms. On Monday, the day prior to her hospital entry at 11:00 a.m. while going about her ordinary household duties she fell over in an unconscious spell which lasted several hours. This spell was attended with very severe pain over the abdomen and all evidence of shock and hemorrhage. She was seen by her local physician who recognized the condition

following gastro enterostomy its frequency varying according to those making the report. It is also accepted that hæmorrhage may recur after gastro enterostomy in 1 per cent of duodenal ulcer cases and 2 per cent of gastric ulcer (Balfour) but it is to be remembered that hæmorrhage occurs in less than 25 per cent of chronic ulcer cases. In most cases in which no ulcer is present hæmorrhage is due to superficial erosions caused by toxic hepatitis a result of focal infection (Mayo). Or it may be due to cirrhosis of the liver splenic anaemia or other causes.

The incidence of gastric carcinoma whether it is believed to result from the degeneration of the edge of a chronic ulcer or to have existed from the start as a carcinoma which is indistinguishable either before operation or on the operating table is another argument in favor of surgical treatment of gastric ulcer. Great difference of opinion still exists as to the frequency of the degeneration of gastric ulcer into gastric carcinoma. This has varied between the figures of 70 per cent in the original reports of several years ago from the Mayo Clinic to less than 2 per cent according to the figures of Wilenski. It is certainly of significance however that the cases studied by an actuary of one of the large insurance companies showed that the life expectancy after operation for duodenal ulcer was the same as that of the normal population of the same age while the death expectancy in cases operated on for gastric ulcer was three times as great. Balfour later revised his earlier figures on the degeneration of gastric ulcer into carcinoma showing that a considerable number of the patients from the Mayo Clinic operated on for gastric ulcer died within such a short period after their discharge from the hospital that it is fair to assume that carcinoma was present at the time of operation. In a number of instances subsequent careful examination of specimens removed from these patients showed carcinoma in some portion of the ulcer. A study by von Fieselsberg of 41 late deaths after operation for gastric ulcer in which 23 postmortem examinations were performed showed that 13 were from carcinoma of the stomach. Also statistics of Joslin of

the Massachusetts General Hospital showed that 24 per cent of the late deaths following gastric ulcer were from cancer of the stomach. Time does not allow here a further consideration of this subject which was more thoroughly analyzed in an article by me on "Carcinoma of the Stomach" published in 1919.

After all facts are better than argument and the ultimate results of both forms of treatment may best be measured by a study of the end results of not one but several large groups of cases. This is extremely difficult except by a long continued persistent and careful follow up because of the known periodicity of symptoms and frequent amelioration of all signs of indigestion in the patient whose ulcer either becomes quiescent or else clears up only to recur.

A large number of reports from the medical clinics where the follow up has been continued over a long period are more difficult to obtain than surgical reports. A considerable number however have been published within the past few years. Sippi stated that he cured 85 per cent of cases of pyloric obstruction of all grades due to ulcer by his method and that only one half of the remaining 15 per cent needed operation. Brown states that the advocates of both surgical and medical treatment claim a cure of from 75 to 90 per cent of ulcers but says that certainly this number is not really cured by either medical or surgical procedure. Eggleston reports on 156 cases which have been treated medically and have been free from symptoms for a period of 3 years. One hundred and thirteen 72 per cent reported no return of symptoms and 43.28 per cent reported recurrence. In this report 80 per cent were ideal cases for medical treatment in that the patients were well nourished had no pyloric stenosis and had no indications of a tendency toward perforation.

Several reports have been made as to the end results of surgical treatment. Mayo states satisfactory results were obtained in 85 per cent of gastric ulcer and in 90 per cent of duodenal ulcer cases without excision. Ninety five per cent were cured surgically but more than one operation may have been necessary in 1 or 2 per cent of the cases. The

## THE SURGICAL TREATMENT OF GASTRIC AND DUODENAL ULCER

BY JOHN DOUGLAS MD FACS NEW YORK CITY

CONSIDERATION of the surgical treatment of gastric and duodenal ulcer presents two problems. First, which cases shall be treated surgically? Second, if operation is determined to be advisable, what surgical procedure shall be carried out? Each of these questions is still a matter of disagreement or rather argument, the former between the internist and the surgeon, while the latter concerning the relative value of different operations is as yet far from being agreed on among surgeons. In fact, during the past year in three papers read before the New York Surgical Society, three different surgical procedures were considered. Possibly the difference in specific conditions encountered prevents any standardization which might simplify the problem.

One reason for the lack of unanimity of opinion as to the first question is the fact that each surgeon bases his opinion on his own limited number of cases. Of a number of patients treated by operation, a certain percentage for various reasons have recurrence of symptoms. Such patients consult the internist who sees a few of these patients but does not see those who have been cured and of course is impressed by the number of uncured surgical cases and therefore argues against surgery. On the other hand, the surgeon rarely sees patients who have not been treated for varying periods more or less adequately by the internist. W. J. Mayo has said that his idea of the time to operate on a gastric or duodenal ulcer is after it has been cured nine times by medical treatment. Scudder states that in a series of cases operated on at the Massachusetts General Hospital for gastric ulcer, the average term of medical treatment was between 5 and 10 years. Finney and Friedenwald give the average time of medical treatment before operation as 9 years.

Some of the elements which make it most difficult accurately to determine the end results of medical treatment and the value of

opinion based thereon are: The difficulty of certain methods of diagnosis, the characteristic periodicity of symptoms which often disappear spontaneously or under treatment only to recur, and the recurrence of symptoms or even perforation after patients have been discharged as cured. Many examples of these conditions are easy to cite. After the most careful history, clinical study and X-ray examination on which a diagnosis of ulcer is based, an operation may fail to demonstrate the lesion. Such a case if no operation is performed would be classed as a cure or a failure to cure of a gastric or duodenal ulcer. On the other hand, after the diagnosis of ulcer is made at operation, a diseased gall bladder or I believe less frequently than is generally stated, the appendix may be found to be the cause of reflex stomach symptoms.

The natural inclination is to remember individual cases that are so striking as to remain in the memory while the usual group makes less impression. I acknowledge that I may be unduly impressed by such cases as the following. A patient with duodenal ulcer was discharged from the hospital as cured after medical treatment and the ulcer perforated a few days later. Another patient after careful roentgenographic examination and medical treatment was referred to the surgical division for operation for ulcer. No ulcer was found, the lesion present being a cholecystitis. One patient entering the third Surgical division at Bellevue Hospital had undergone careful treatment for 8 weeks with the Lenharz diet in a hospital in another city and he brought a careful copy of the notes of his treatment. He was discharged cured. Four weeks later he was operated on in Bellevue Hospital and a large unhealed active ulcer found.

As an argument against operation, the internist cites cases in which the patient still complains of symptoms or of marginal ulcer as a post-operative complication. This latter does occur in a certain percentage of cases

ulcers of the stomach which are of the penetrating type call for surgical treatment. It is very likely that those cases in which a large deforming ulcer of the body of the stomach exists have little prospect of cure by other than surgical means. Surgery should not be used in acute cases or in those with a short history or a history of never having had the benefit of adequate proper medical treatment. A gastric residue does not necessarily mean an organic stenosis of the pylorus as reflex spasm and oedema may be a large factor in causing the retention and this may often be relieved by medical means. And in most instances this should be attempted. But it would appear that a large percentage of these patients is relieved, not cured, and the symptoms will recur.

The operative mortality is of course advanced as an argument against surgical treatment and justly so, but the operative mortality in uncomplicated cases of duodenal ulcer is small. Mayo reports 1 to 2 per cent. Crile in cases of simple gastro-enterostomy alone less than 1 per cent. Scudder in 171 gastric ulcer cases reports a mortality of 7.6 per cent in 139 duodenal ulcer cases, 6 per cent (but does not state whether this included cases of perforation). Pool in 70 cases 7 per cent, but it is not more than fair to state that of the 5 deaths 1 was due to delirium tremens and 1 to septicæmia following mastoiditis. The operative mortality in the St. Luke's series has already been given.

The death rate following the more extensive operations such as resection, transgastric or midgastric, and the various types of pylorotomy, one would expect to be higher. But the type of cases requiring such operation are just the ones in which the prospect of cure by medical treatment is least, the symptoms most severe, and the possibility greatest of the presence or the development of carcinoma. In such cases also must be considered the danger of perforation, even while one acknowledges that perforation may frequently occur from an acute pathological process without the previous existence of an old chronic indurated ulcer. In the hands of the skilled gastric surgeon, even these more radical operations show a surprisingly low

mortality. Haberer has published a report of 256 Billroth I operations or modifications thereof for gastric and duodenal ulcer with a 5 per cent mortality, while in resection for duodenal ulcer Friedman reports a 2.6 per cent mortality in 115 cases, and Finsterer 3.6 per cent in 272 cases.

Solution of the second problem, the choice of operative procedure, cannot be accomplished by the theoretical establishment of an ideal procedure and the effort to attain that ideal. Lack of knowledge of all of the etiological factors entering into the cause and recurrence of ulcer prevents the determination of an exact cure. In duodenal ulcer gastro-enterostomy, even if not ideal, has been acknowledged by most American surgeons to be a successful method of treatment. If the ulcer is in the anterior wall it may be excised or cauterized and possibly the small number of hæmorrhages occurring after gastro-enterostomy lessened. But even this is uncertain. In 1 case of perforated ulcer operated on about 4 years ago in which the edges of the perforation were excised, the perforation carefully closed, and the area infolded, and a gastro-enterostomy performed, a rather severe hæmorrhage subsequently occurred, but this was found to be due to a jejunal ulcer. In 2 other patients operated on about the same time, both of whom had developed severe hæmorrhages before operation, and in 1 of whom two transfusions were necessary before operation, nothing but gastro-enterostomy was done, both were perfectly well and had no recurrence of any symptoms when seen recently. In the ulcers of the posterior wall those which are most prone to bleed, excision of course is not practical.

Gastro-enterostomy however has fallen into more or less ill repute. I do not believe this is deservedly so. Of course if not properly placed, if too large, if the distance from the duodenojejunal junction is too long, or so short as to produce tension or allow kinking or angulations, if the edges of the anastomosis are not carefully sutured, the maximum physiological function will not be attained. I have seen a gastro-enterostomy so large that everything entering the stomach practically fell into the jejunum. Of course, under

mortality was under 2 per cent in all cases. More recently Balfour, reporting on 1000 cases, all operated on 10 or more years ago states that 88 per cent were cured and that there were only 3.5 per cent of recurrences. Finney gives end results of gastro enterostomy as 77.2 per cent of cures with 88.6 per cent of complete cures by means of pyloric plasty. Pool reports 50 patients well out of 59 cases followed up after gastro enterostomy. 84 per cent. Deaver gives 80 per cent entirely well and 10 per cent markedly benefited but having occasional digestive upsets due to indiscretions of diet. Scudder's analysis of 108 cases of chronic gastric ulcer showed 99.91 per cent well of 94 cases of duodenal ulcer 88 well 93.6 per cent. The most recent English statistics quite closely correspond to American. Moynihan reports cures in 90 per cent of his cases. Sherren reporting on 500 cases states that 92.6 per cent were well 2 or more years after operation. Walton in 114 cases reports 85 per cent cured and 10 per cent improved.

Examination of the cases of gastric ulcer operated on by the various members of the Surgical Staff of St. Luke's Hospital New York from June 1 1918 to October 1 1924 the period during which the follow up has been in operation showed a total of 68 cases operated on by gastro enterostomy with excision or cauterization of the ulcer or both. The operative mortality was 7.5 per cent 5 cases or if 1 case operated on for perforation be excluded 5.8 per cent. One patient died 2 years after operation from carcinoma. Eleven cases could not be traced. There were, therefore 52 cases followed. Of these 48 92.3 per cent were reported cured 3.53 per cent improved and 1.24 per cent failure. The causes of death exclusive of the case of perforation were in 2 cases pneumonia in 1 uræmia and in 1 profound anemia. In addition to the 68 cases treated by gastro enterostomy there were 14 cases of gastric ulcer treated by pyloric or midgastric resection with 1 death (6.7 per cent) 1 case we lost track of and the 14 remaining patients were cured or made no complaints.

The records of 144 cases of duodenal ulcer operated on during the same period at

St. Luke's Hospital showed 15 deaths 10.2 per cent but of these 15 deaths 5 followed operation for perforated ulcer 1 died from pernicious anemia and 2 were associated with lesions of the biliary tract, 1 of which showed cholelithiasis and cholecystitis the other common duct obstruction. If these be excluded the mortality was 5.8 per cent. Of the 100 cases followed 90 per cent are reported cured. Five were improved but had some symptoms after indiscretions in diet. Five patients 5 per cent were unimproved.

However there are a number of surgeons particularly those in Europe who for several years have been dissatisfied with the results of excision and gastro enterostomy and have reported very different results from their operations.

Finsterer, of Vienna during a visit to this country in the fall of 1923 quoted the following statistics. Payr had in his material 62 per cent recoveries and 38 per cent failures. Bier 66 per cent and Haberer 37 per cent recoveries.

Many reports from the French clinics also show unsatisfactory results. The series of statistics giving the worst results after gastro enterostomy for the treatment of duodenal ulcer, published by an American surgeon are those of Lewisohn in SURGERY GYNECOLOGY AND OBSTETRICS January 1925. He reports that examination of 68 cases 4 to 9 years after operation showed 47 per cent completely cured and 19 per cent with a fair result. Thirty four per cent of the patients had gastrojejunal ulcers. In 12 18 per cent a second operation was performed. In 11 16 per cent the diagnosis was based on clinical symptoms and X ray findings. The mortality in 213 cases of all kinds of stomach operation for the period from 1915 to 1920 was 22.10 per cent plus.

This latter group of statistics is the basis for the advocacy of the more radical operations such as subtotal gastrectomy and the many other types of operation which have been suggested during the past few years and which will be considered when the choice of operation is discussed.

It is generally conceded that acute perforation, marked stenosis and most of those

While the mortality from these radical operation in the hands of the skilled gastric surgeons have not been very large it must be, that if the surgeon not doing many such extensive resections adopts this method many more cases will be lost than if a less radical procedure were followed. And it is also my belief that perhaps the end results following these radical procedures if followed over the long period that gastro enterostomy with or without excision or the methods of pyloro plasty have been followed may not justify the increased danger and be entirely free of any and all unpleasant sequelæ.

In the operative treatment of gastric ulcer the excision of the ulcer if large is the ideal to be attained. If the ulcer is in the pyloric region, excision may best be done by a pylorotomy after the Polya Balfour or the older Billroth II method. The former is easier more rapid and gives better functional results. In a recent article Woolsey especially favors this type of operation and our statistics at St Luke's show the lower mortality and good end results after the Polya Balfour resection. It is my belief that a small enteric anastomosis between the limb of the loop below the point of anastomosis will improve the results of the Polya operation. Some of these large indurated ulcers cannot be distinguished from carcinoma at the pylorus and I have in 3 instances done a pylorotomy for what I believed to be carcinoma; the microscopic examination showing no carcinoma cells in a large greatly indurated ulcer.

If the ulcer is small on the lesser curvature near the pylorus excision with the knife or cautery or the Balfour method of cauterization plus gastro enterostomy has given the best results according to our statistics. I do not believe that excision alone without gastro enterostomy will cure most of these patients. Strauss has recommended the resection of the lesser curvature of the stomach in such cases combined with a removal of a considerable portion of the pyloric muscle to shorten the emptying time and allow regurgitation into the stomach. With this procedure I have had no experience.

Small ulcers of the posterior wall may be excised by the transgastric method but in

the case of larger ulcers of the lesser curvature and posterior wall, the midgastric or sleeve resection is the operation of choice. This applies particularly to those cases in which the ulcer is situated at such a distance from the pylorus that a pylorotomy is not indicated and in which the stomach is of the hourglass type. Contrary to some reports these patients usually do well, with relief of symptoms and although the hourglass deformity may sometimes partly return as shown by follow up roentgenographic examinations they rarely show the retention present before operation.

Those ulcers situated high up on the lesser curvature often of the penetrating type sometimes adherent to the liver are most difficult to deal with. In 2 cases of my own, a resection of the adherent portion of the liver which formed part of the base of a large ulcer allowed a pylorotomy in one instance and a midgastric resection in another. In both instances the lesion was believed to be carcinoma the hæmorrhage from the liver was easily stopped by means of suture and both patients recovered. In some cases however the adhesions are so dense that the lesser curvature cannot be freed, and in such, the choice of procedure lies between a gastro gastrostomy and a gastro enterostomy. In one patient of mine with such a condition, symptoms of ulcer having been present for 10 years the patient was greatly relieved although not entirely cured of occasional symptoms by a gastrogastrostomy. This patient was reoperated on 2 years ago, the X ray showing obstruction in the descending colon as well as gall stones. There was an inflammatory band obstructing the colon and division of this band together with cholecystectomy relieved the symptoms. The stomach between the gastric pouches remained of good size and functioned well.

For high ulcer of the lesser curvature gastro enterostomy theoretically, should cause little benefit and this statement is made in most articles on gastric surgery, but excision is most difficult and it is of much interest to note that in 3 cases of such nature in the list of cases analyzed from St Luke's Hospital this seemed to be the only possible

such conditions it is reasonable to expect intestinal indigestion. Much has been written of the liability of the gastroenterostomy stoma to close particularly if the pylorus remains patent. In none of those gastroenterostomies done at St. Luke's Hospital has the stoma been known to have failed to remain patent. However in the case of a patient who had been operated on 5 years previously in another city I found the stoma closed although the pylorus was also tightly occluded. However it must be a very rare occurrence. It is my belief that by far a more common source of postoperative trouble is that too large a stoma allows too rapid emptying of the stomach contents. A series of 14 cases checked up at varying times after operation in the X-ray department of St. Luke's Hospital by Dr. Le Wild 2 or 3 years ago would seem to verify this opinion.

A very interesting suggestion as to the failure of gastroenterostomy to cure ulcer or to function properly is that advanced by Devine before the meeting of the American College of Surgeons in 1924 and published in *SURGERY, GYNECOLOGY AND OBSTETRICS* in January, 1925. He postulates that the cure of the ulcer and relief of symptoms depends on the proper neutralization of the hyperacidity by regurgitation of the alkaline intestinal juices and states that two mechanical causes may prevent this. Either a spur formation occurs at the gastroenterostomy stoma which directs all the flow into the stomach or an axial twist of the intestine at the point of anastomosis prevents a sufficient regurgitation or proper drainage.

It has been generally stated in the American literature that gastrojejunil or jejunal ulcer followed gastroenterostomy in 1 to 3 per cent of cases. In the German literature this was estimated to occur in from 5 to 10 per cent of cases and now Lewinsohn has reported as previously stated 34 per cent. This number of gastrojejunal ulcers and the reported poor results from the foreign clinics caused the advocacy of more radical treatment of duodenal ulcer. Haberer was one of the first to use extensively the method of pyloric resection for duodenal ulcer performing the anastomosis, a gastroduodenostomy, by the

modification of the Billroth I method. This procedure was adopted by many European surgeons. Finsterer however stated that this was followed by many recurrences and in his lectures 18 months ago said that already 29 recurrences of ulcer had been observed. He therefore advocated and practiced a resection of two thirds to three fourths of the stomach for duodenal ulcer with an anastomosis by the Polya method.

When the ulceration of the duodenum is situated so near the papilla of Vater or is so extensive that removal of the duodenum is impractical, he divides the stomach proximal to the pyloric muscle, resects the antistal portion of the stomach and anastomoses the remaining portion to the jejunum.

Many other methods have been suggested of avoiding gastroenterostomy. The Finney method of pyloroplasty has stood the test of many years but cannot be done if the duodenum cannot be mobilized. C. H. Mayo has recently suggested a modification of the Finney method. Erdmann has recently reported on 50 cases of pyloroplasty done by the Horsley method with 90 per cent of cures. It is of interest to note that Erdmann reports an increasing number of cholecystectomies in the last of this series of cases.

It is extremely difficult to reconcile the statistics of those advocating the very radical operations for duodenal ulcer because of the frequency of gastrojejunal ulcer and other bad results with those still adhering to the less radical measures. I feel that I am expressing the opinion of all of the surgical staff at St. Luke's Hospital where this class of patients have been carefully followed during the last 5½ years in the figures here given which are a fair expression of the belief that these results are too favorable to justify the radical operation of subtotal gastrectomy for duodenal ulcer. These radical operations are based on the theory that only by removing the hyperacidity can ulcer be cured and that while the acid forming glands are in the fundus of the stomach resection of the pyloric two thirds removes the hormone which stimulates these glands to action. Finsterer states that hyperacidity is greater in duodenal than in gastric ulcer cases.

the patient has recovered from one severe hæmorrhage when the X ray shows marked deformity particularly in gastric ulcers and when the condition has been present for a long time

## II Choice of operative procedure

1 Gastro enterostomy with or without excision and the various method of pyloroplasty are not ideal procedures because they do not remove all the etiological factors of ulcer

According to most of the American and English statistics the average percentage of cures is in the neighborhood of 85 to 90 per cent

3 Sometimes the complications of jejunal ulcer may be worse than the original lesion

4 Although the continental statistics and the percentage of cures of a few American surgeons show unfavorable results after gastro enterostomy with or without local excision our follow up at St Luke's Hospital New York and most American statistics do not appear to justify radical gastric resection for duodenal ulcer or small gastric ulcer

5 Careful technique pre operative preparation and after care of the patient will lessen the mortality and increase the number of cures without radical operation



procedure and the follow up shows all these cases relieved of symptoms. In 1 patient with the lesser curvature and posterior stomach wall so adherent or indurated that posterior gastro enterostomy could not be done an anterior gastro enterostomy with an entero enterostomy has caused complete relief of symptoms more than 2 years later. Rarely one meets with a stomach lesion in which the pathological condition is such that resection on account of extreme ulceration and adhesions presents insurmountable difficulties without greatly endangering the life of the patient and even a gastro enterostomy seems impractical. In such cases a jejunostomy may give the ulcer time to heal and either allow a cure or a second operation when necessary. Moynihan has advocated this method of treatment either alone or with an anterior gastro-enterostomy and in 1 case from the St. Luke's series in which the jejunostomy was left open for a year a large increase in weight with a marked improvement of the stomach lesion has resulted, and now 2 years later the patient is symptom free.

In the treatment of acute perforation it is now generally conceded by most surgeons that closure of the perforation with or without excision of the ulcer and without an accompanying gastro-enterostomy is the operation of choice. If the perforated ulcer is at or near the pyloric ring an excision followed by a pyloroplasty after the method of Horsley has given excellent results.

We will probably never cure 100 per cent of our ulcer patients either by medicine or surgery, unless we can know all the factors which enter into the etiology and remove all the causes of ulcer. In one of my cases I excised an ulcer of the lesser curvature but did not do a gastro enterostomy. Symptoms recurred after 2 years and at a second operation a duodenal ulcer was found. A gastro enterostomy was done and the patient has been well since over a period of 6 years. Patients who develop gastroduodenal marginal or jejunal ulcers after gastro enterostomy are apt to develop ulcer again after a second or even third or fourth operation. Resection of the stomach after the Polya method seems to be indicated in these cases.

Many years ago Rodman advocated pylorotomy for chronic ulcer to remove the ulcer bearing area, but Cole and Hoguet have reported a large marginal ulcer after a Polya operation and Lewinsohn 3 cases following Billroth II operations while the 29 cases reported by Finsterer after the Haberer operation have been mentioned already. Of course the advocates of the radical operation for duodenal ulcer are equally radical in the case of gastric ulcer and it would seem to me with better reason. But that three fourths or more of the stomach should be removed for a small ulcer of the lesser curvature or anterior wall of the stomach or for a duodenal ulcer still appears to me a question to await final decision for the reason I mentioned in discussing the treatment of duodenal ulcer.

Therefore to attain the best possible results it is necessary in addition to the best operative procedure to carry out as careful after treatment as to diet and so forth as the patients themselves will allow. Treatment should also be given before at the time of operation and afterward in an effort to remove or prevent those foci of infections which are most probably factors in the etiology of the patient's lesion. It has been my observation that most of the patients who have unsatisfactory results after operation complain of persistent constipation.

It has been stated that about 50 per cent of the mortality following gastric operations is due to chest complications and therefore our mortality will be lessened materially by careful pre operative treatment, the avoidance of operation in the presence of a beginning cold or coryza or sore throat, cleaning up a dirty mouth, teeth or tonsils before operation and the use of a local anesthetic in bad risks.

#### SUMMARY

I. Choice between medical and surgical treatment

1. If the case is acute or in the presence of acute hemorrhage medical treatment should be tried first and given every opportunity to cure the patient.

2. Operative procedure should be employed after medical treatment has failed when there are repeated hemorrhages when

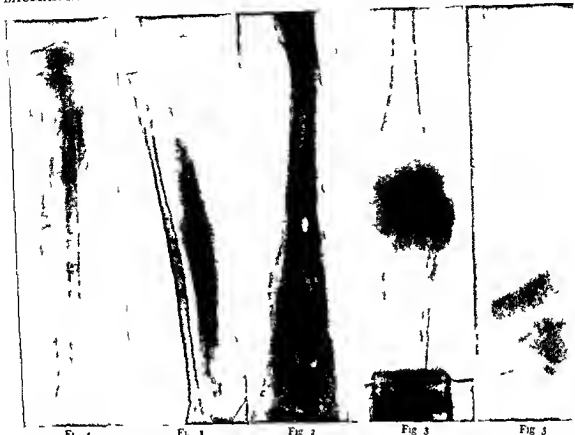


Fig. 1. Case 2. Note the involvement of the tibia from one epiphysis to the other. The entire diaphysis was resected and lifted out of the periosteum with little effort.

Fig. 2. Case 2. Showing the marked bony involvement of the right femur before operation also fracture from attempted reduction of dislocation of hip.

Fig. 3. Case 2. Showing the extent of the resection of the femur about 6 inches.

and 2 months later respectively healing and regeneration of the bone progressed with final cessation of the discharge about 18 months later. Two years after the operation the femur was found to be much bowed anteriorly probably because traction was not used and too much reliance had been placed upon the cast. The knee was ankylosed and the foot in equinus position. A tenotomy of the Achilles tendon was performed and a month later the patient fell while wearing a cast fracturing the regenerated portion of the femur. Union occurred rapidly and now 4 years after the operation the patient is walking well without pain without discharge and with 23 1/2 inches shortening.

The progress of this first case does not sound alluring and yet the result has been much better than after many less radical procedures.

CASE 2. I. O. a white boy of 9 years injured the left foot on a nail in September 1920 the wound becoming infected and being incised at a hospital

Two months later osteomyelitis developed in the left tibia which was incised and drained. After another 2 months pain developed in the right hip and the X-ray showed dislocation which was reduced under anesthesia but soon recurred. Six months later in March 1921 he entered Lakeside Hospital presenting dislocation of the right hip with osteomyelitis of the femur two sinuses over the left tibia one over the left fibular head and a small nodule over the head of the second right metacarpal which 3 or 4 months before was tender and reddened but had receded spontaneously. The patient was in very poor general condition with marked toxic manifestations. Attempt at reduction of the hip resulted in fracture of the femur. Three weeks later incision over the left tibia showed the bone to be so badly diseased (Fig. 1) that the entire shaft could be lifted out with very little effort. At intervals thereafter incision and curettage of the following sites was performed: head of left fibula; head of the right second metacarpal and right internal malleolus. In August 6 inches of the lower end of the right femur was re-

## RESECTION OF LONG BONES FOR CHRONIC OSTEOMYELITIS

BY GEORGE I. BAUMAN, M.D. AND HORACE E. CAMPBELL, M.D. CLEVELAND, OHIO

**T**HE management of osteomyelitis is probably one of the most discouraging aspects of the practice of surgery. The disease so resists treatment that the unfortunate subjects undergo large numbers of operations without eventual cure and often carry discharging sinuses throughout a long period of their lives. Resection of the diseased bone has been advocated by several but apparently has not been generally accepted.

In 1900 in the course of performing a sequestrectomy for chronic osteomyelitis we did an actual resection of the shaft. While the healing and regeneration were not good in this case (Case 1) it presented the possibilities of the method and further resections for chronic osteomyelitis have been performed. We have resected portions of the long bones in 23 patients with a total of 28 resections. The results have encouraged us in the belief that this method may be a cure for chronic osteomyelitis in children at least.

Since the monumental work of Ollier in 1867 it has been known that the periosteum is capable of completely regenerating a new diaphysis. His results were not of the best because he did not distinguish between tuberculous and infectious lesions and because antiseptics had not been developed. Cheever (3) in 1870 was the first in this country to report operations in accordance with the principles laid down by Ollier. Nichols (7) in 1898 carefully described a method for the successful removal and regeneration of the diaphysis. He advised the subperiosteal resection of the shaft at about the eighth week after the subsidence of the acute process, that is, at a time when the periosteum had begun to form bone but had not yet formed a rigid tube. The periosteal cavity lined with a thin shell of bone was then disinfected with 95 per cent carbolic acid followed by alcohol, the inner surface of the tube approximated and the edges sutured with chromic catgut. The skin and muscle were closed over the periosteum

leaving small gauze or catgut wicks for drainage. Bone formation was palpable at the third week and went on to good functional results. Eight of the eleven cases reported in 1904 attained perfect results and the others were fair.

Our resections have been performed with one or two exceptions upon cases of chronic osteomyelitis which have had discharging sinuses from 4 months to as many years. The technique has been to resect as much of the diaphysis as has been diseased and to sew the periosteal edges together over perforated rubber drainage tubes allowing the tubes to protrude from either end of the incision. The tubes have varied in size from the ordinary Dakin's tube to a large tube  $\frac{3}{4}$  inch in diameter. The large tube was used in but a few cases. Dakin irrigations have then been carried out by means of the tubes and they have been allowed to remain for 2 to 5 weeks depending upon the duration and character of the discharge. Regeneration of the bone has proceeded in most cases with surprising rapidity and the patients have attained a complete functional cure with but little deformity of shortening. There have been some failures of regeneration and these will be discussed with the presentation of the cases. The patients are kept in bed with extension for 8 to 10 weeks, then allowed to walk with crutches and a cast or brace till the sixth month and then allowed partial weight bearing with brace or cast till the eighth to tenth month.

**CASE 1.** J. P., a girl of 13 years, entered the hospital in March 1920 with a 6 month history of swollen painful knee following incision and drainage of acute inflammation of the lower end of the left femur. Examination showed the left thigh atrophic with the knee fixed in flexed position, fixed patella fluctuation of the joint capsule and two discharging sinuses in the posterolateral aspect of the lower end of the thigh. Operation was performed and the lower end of the femur found to be a mass of sequestra, their removal resulting in a resection of the lower end of the femur. The periosteal cavity was packed with gauze and the leg placed in a hip spica cast. After the subsequent opening of abscess cavities 1



Fig. 4. Case 2. Showing right femur 4 years after resection of about 6 inches of shaft. Note apparent medullary cavity.  
 Fig. 5. Case 3. Four years after the resection of the left tibia. Note the apparent medullary cavity.

end of 16 months there was some discharge from the region of the left hip and removal of a small sequestrum was performed. The femur had regenerated to the size of the original bone but there was absence of the mid portion of the tibia (Fig. 7). The boy has walked very well with the aid of a brace and there has been no evidence of infection for 2 years. There is ankylosis of the hip with 13 1/2 inches shortening of the right extremity. The fibula has been grafted into the tibia (Fig. 8).

It is interesting that the two cases of non-regeneration have occurred in patients in whom the femur was resected soon after the resection of the small bone. The question is whether or not these bones would have re-

generated if there had not been regeneration of the larger bone with a better blood supply going on synchronously. However we have other cases of non-regeneration of the tibia when it was the only bone resected. It has been the experience of other workers that the tibia while favorable for resection in that it has the adjacent fibula for a splint does not always regenerate probably because it is endowed with a relatively poor blood supply. The occasional failure of union in osteotomies of the lower end of the tibia is likewise usually attributed to the fact that the nutrient artery of the tibia extends proximally from its

sected (Fig 3). By this time a rather well marked foot drop had developed as a result of injury to the peroneal nerve while the head of the fibula was being curetted. In January 1922 suture of the peroneal nerve was performed and in September of the same year two years after the original injury the patient was walking without aid presenting some degree of foot-drop  $\frac{3}{4}$  inch shortening of the left leg some limitation of movement of the right knee and almost complete fixation of the right hip. In March 1925 the patient is walking  $\frac{1}{2}$  mile to school and there are no signs of infection anywhere. The femur and tibia (Figs 4 and 5) have reformed strikingly although there is a 2 inch shortening of the left leg the leg in which the tibia was resected the femur being resected in the right. The shortening is apparently due to destruction of the distal epiphysis for both were somewhat involved and the resection included the entire diaphysis.

CASE 3. R. M. A white female developed an infection of the left foot at the age of 4 years which was incised by a physician with the evacuation of pus. There has been extension of this process over the body until she presents on admission to the hospital 3 years later on March 30 1921 three sinuses over the left clavicle two at the upper end of the left humerus one over the right forearm with extensive scarring and deformity of the wrist one over the upper end of the left femur and great thickening of the left ankle. The child had a most severe osteomyelitis and was in very poor condition. The following operations were performed April 15 incision and drainage of the left femur April 16 removal of sequestra from the left clavicle and left humerus April 20 resection of the right ulna May 6 resection of the entire left femur neck to the condyles June 17 incision and drainage of abscess of left thigh June 20 incision drainage and curettage of left mandible July 25 resection and curettage of the left tarsus. About a year later all wounds had closed the femur had entirely regenerated the ulna had failed to regenerate and the patient was leading an active normal life. In January 1924 she fell and struck the right hip and developed pain swelling and redness. This subsided but reappeared in April and the X ray showed complete destruction of the head with dislocation of the trochanter upward (Fig 6). This was undoubtedly an old process. The abscess was incised and drained but no connection was found with the bone or joint. Three weeks later a good sized abscess was discovered under the scar over the left humerus. This was incised and drained without there being any apparent communication with the bone. Both wounds healed promptly and hence 4 years after the first resection the patient presented complete regeneration of the left femur (Fig 6) with all motions of the hip joint free with good motion at the knee and with considerable shortening which is admittedly much less than it would have been had there not been the dislocation of the head of the right femur. The right ulna partially is absent the left humerus is solid but

irregular and the left clavicle has completely regenerated. There is slightly exaggerated mobility of the right elbow and wrist and the left foot is in slight valgus.

It should be stated that these resections were operations of necessity and not of choice. The practical results both healing and functional have been excellent. It is noteworthy that the reappearance of the disease after 2 years of entire freedom was not in the bones that had been resected and that the origin was probably in the left humerus which had been merely saucerized. The failure of regeneration of the small bone was seen here to be associated with the resection of the larger and better nourished bone the femur.

CASE 4. M. V. age 10 months entered the hospital with several discharging sinuses over the left upper arm and with much tenderness along the whole length of the humerus. The disease began at the age of 2 months and the only operations had been small incisions for the escape of pus. There was almost complete ankylosis of the elbow joint but supination and pronation were good. Four days later April 25 1921 incision was made over the lateral aspect of the arm from the shoulder to elbow and almost the entire shaft of the humerus found to be much diseased and was accordingly removed with little difficulty. The periosteum was packed open with iodoform gauze and the arm placed in an extension apparatus. Two months later the X ray showed beginning bone formation. Extension was removed at about 6 months and progress seemed good until 10 months after the operation when a fracture was noticed there being no history of violence. Four months later union was good there was fairly good motion at the shoulder but still almost complete ankylosis of the elbow. Now 4 years later he has a firm bone with  $2\frac{1}{4}$  inch shortening and moderate deformity. He has no sign of infection and has had no more fractures. Function is as good as could be expected with almost complete ankylosis of the elbow. The X rays show a solid thick humerus with no deformity except at the extreme lower end which is very irregular. This together with the fact that he had a pyogenic arthritis accounts for the stiff elbow.

CASE 5. E. R. a white male was operated upon for acute osteomyelitis of the right femur and tibia in 1920 at the age of 3 and a second operation was performed 6 months later at the same sites. He entered Lakeside Hospital 1 year after the onset of the disease presenting discharging sinuses over the leg and thigh with thickening of the femur and tibia. In July 1921 the entire diaphysis of the right tibia was resected and a month later the upper two thirds of the femoral diaphysis of the same side. At the



Fig 9

Fig 10

Fig 9. Case 8. Ten months after the resection and immediately after the fracture showing the width of the bone and the site of the fracture.

Fig 10. Case 8. Nine months after the fracture to show the thickness of the femur. Undoubtedly the fracture is due to the poor shape of the bone which may have been caused by allowing the patient to walk without other support than a cane at the much too short interval of 4 months after the resection. Nine months to a year is the usual interval allowed now.

the use of a brace was continued until 20 months after the fracture. Motion of the knee was good although slightly limited. Three years after the fracture the patient is walking with a cane with  $3\frac{1}{2}$  inch shortening and shows no signs of infection. The femur is regenerated firmly although somewhat broader and flatter than the original bone and the use of the cane is continued for greater security (Figs. 9 and 10).

CASE 9. C. F. a white male entered the hospital at the age of 16 years having had incision and drainage operations upon the ulna and upper end of the right femur within the preceding year. He presented on admission two sinuses over the lateral portion of the right upper thigh three over the outer end of the left clavicle and a healed scar over the lower end of the right ulna. The head and neck of the femur were thoroughly curetted and 9 months later the patient was walking without the aid of a cane there being firm ankylosis of the hip with discharge from a small sinus. However the clavicle was still discharging and this bone was resected. A year after the operation on the femur the process in the ulna reawakened and the ulna was resected leaving a half inch below and an inch above. Healing and regeneration proceeded rapidly and two years later

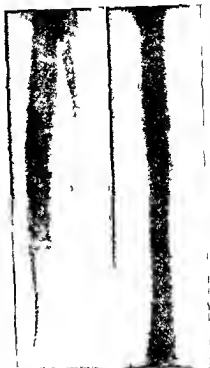


Fig 11 Case 9. Two months after resection

in November 1924 there were no discharging sinuses the bones were all firm there was but 1 inch shortening of the right leg and perfect function of right elbow and wrist (Fig. 12).

CASE 10. J. P. a white female entered the hospital in May 1922 at the age of 16 years. In the fall of 1920 an abscess of the hip was opened and discharged for several months until the knee of the same leg became swollen the latter condition improving considerably under the influence of baking. On admission the X-ray showed some roughening of the bone with periosteal thickening and there were signs of abscess in the lower outer portion of the thigh. There was a definite abscess cavity about the bone with a shell like portion of bone lying free but there were no sinuses leading into the bone. The wound almost healed and then broke down again following which resection of about 7 inches of the lower end of the femur was performed. Convalescence was stormy the knee joint became infected but was cured by repeated aspiration of the purulent material. 4 months later a large abscess developed on the medial aspect of the thigh. After about a year firm union had occurred and the patient was walking with good motion of the knee but with 2 $\frac{1}{2}$  inches shortening. Eighteen months after the resection an abscess developed on the medial aspect of the thigh and when it was opened a small piece of bone was found. The wound promptly healed and the patient is at present entirely healed with good motion of



Fig 6 Case 3 About 3 years after the resection of the distal femur and just before the drainage of the abscess of the right hip. The deformity and shortening are apparent. The anatomical result in this case has been very poor but the functional and therapeutic results quite good.

entrance at about the junction of the middle and lower thirds.

**CASE 6 G G** a white male entered the hospital in February 1921 at the age of 3 with abscess of the right hip which was incised and drained. In September the process had again become acute and the entire upper half of the right femur was resected with the evacuation of large amounts of pus. Subsequent abscesses required incision during the next 2 months. In October 1924 he presented a solid femur with but 2 inch shortening with flexion of the hip to the right angle good adduction fair abduction good rotation and all scars healed solidly.

**CASE 7 J S** a white male age 10 years entered the hospital in November 1920 having had incisions made over acute inflammatory processes in both tibiae about a year before with incision and curettage at a hospital in another city 6 months before. He presented discharging sinuses over the lower halves of both tibiae and the ankles were swollen and of limited motion. There was an apparently healed sinus under the right clavicle. Both tibiae were carefully curetted the right healed well and a small sinus persisted in the left. A year later the process in the right clavicle reappeared and the entire clavicle was resected subperiosteally. Four months later all sinuses were healed but in another month there developed an acute osteomyelitis of the external condyle of the left humerus with involvement of the elbow joint. This was incised, drained and healed with normal joint motion. The process in the left tibia then lighted up and the entire diaphysis was resected it being necessary to



Fig 7

Fig 7

Fig 8

Fig 7 Case 5 Two and one half years after the original resection. The patient walked about well with the aid of a brace and is now undergoing operation for bone graft of the fibula into the tibia ends.

Fig 8 Case 5 Showing fibula grafted into end of tibia.

curette the talus with the establishment of a sinus through the epiphysis. The wound healed completely in 2 months and in 6 months the patient was walking without aid. Two years after the resection of the tibia the patient returned complaining of pain in the leg and the X-ray showed an ununited fracture of the regenerated portion of the bone. There was slight evidence of inflammation which has disappeared on the application of a cast and the union is now very firm. The ankle is ankylized and there is no evidence of infection in other bones of the body.

**CASE 8 A M** a white male entered the hospital in November 1921 at the age of 17 years. He had been operated upon twice before with saucerization procedures the last time in 1916 and had remained entirely healed for 4 years. The X-ray showed osteomyelitis of the lower end of the femur and that portion of the bone was resected. The progress was excellent the patient walked with a cane in 4 months and the discharge had entirely ceased in 8 months. Ten months after the resection the patient fell and broke the regenerated portion of the bone with opening of the old sinus. Eight months later the discharge had entirely ceased and there was good union but

granulations which led up directly toward the epiphysis. This was curetted leaving an opening 1 inch deep and  $\frac{3}{8}$  inch in diameter. Two rubber tubes were then inserted meeting in the center one coming out at each end through the periosteum. The periosteum was carefully sutured together over these tubes. The leg was placed in a Thomas splint and after 6 hours the wound was irrigated hourly with Dakin's solution through the tubes. There was a rather marked febrile and cardiac reaction but this subsided in 6 days. A series of X rays (Figs 13 a 13 b 13 c) showed rapid bone formation. Dakin's irrigations were continued for 1 month and then saline was substituted since the discharge had become less purulent and much less profuse. The tubes were loosened after about 2 weeks and were entirely removed at 5 weeks. Irrigation was then carried on with a syringe the periosteum being patent from one opening to the other. Not quite 2 months after the operation the patient complained for the first time of pain in the left humerus. She had no elevation of temperature. Examination showed very definite thickening of the mid portion of the bone. This had not been noticed before the operation although no X rays had been taken of the arms. The X ray now showed marked periostitis with destruction area in the medullary substance of the bone. There is also slight eburnation. It was the opinion that this process antedated the resection of the tibia. Saucerization of this lesion was immediately performed with very little reaction. Both wounds healed very well although some small sequestra were extruded from the tibial wound. Six months later the discharge has ceased and while weight bearing has not been allowed the bone is very solid.

#### SUMMARY OF CASE REPORTS

The case reports include the resection of 21 long bones in 16 patients. Five patients had 2 resections each. There were 9 femora all but 1 of which (Case 14) have regenerated completely and firmly 2 showing the maximum shortening of about 3 inches (Cases 1 and 9). The 1 case in which regeneration did not occur was in an adult male of 40 years in whom the age is undoubtedly the causative factor of the failure. However after about a year union is becoming much firmer and it seems as though he may still get a good functional result except for shortening.

There were 6 tibiae 2 (Cases 4 and 10) have only partly regenerated one possibly because the femur was resected at about the same time and 1 because the lower epiphysis was sacrificed (Case 10 luetic). One fractured at the end of 2 years with poor union but has be-

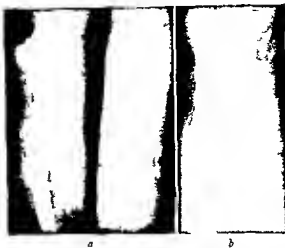


Fig 12 Case 15 a b Two and one half months after resection of 3 inches of shaft of femur. Showing complete regeneration 11 months after resection. Patient has now less than  $\frac{1}{2}$  inch shortening.

come firm under the influence of immobilization (Case 6). Three have regenerated solidly although one has not yet been subjected to weight bearing.

There were 2 ulnae 1 of which failed to regenerate possibly because the femur was resected at about the same time (Case 3). Of the 2 clavicles both have regenerated completely as has the 1 fibula and 1 humerus.

In the first 13 of the cases, or in other words the first 18 resections 2 years or more have transpired since the operations and the results have more finality than the last 3 although osteomyelitis is a disease about which final results must be given cautiously. In every case but one (Case 14 the adult) there has been a decided improvement in the general health. We have personally examined within the past few months almost all of the cases reported and to the best of our knowledge there is only 1 discharging sinus (Case 14) in the series of 21 resections. Of the 21 resections there has been incomplete regeneration in 4 (19 per cent) fractures in 4 (19 per cent) recurrence of infection in 2 (10 per cent) of which 1 was merely an abscess about a small detached piece of bone healing occurring promptly without shaft involvement and the other was the appearance of infection in a bone other than the 2 which had been resected probably having as the source a bone which



the knee. There is 3 inches shortening of the extremity partly due to deficient traction. This is the maximum shortening that has occurred.

**CASE 11.** E. P., a white girl at the age of 12 developed an ulceration of the leg at the junction of the upper and middle thirds. The Wassermann was positive and the ulcer responded to antituberculous therapy remaining healed for a year. The ulcer again recurred exposing the bone this time and both bones of the leg were fractured by a fall with healing of the fibula but only fibrous union of the tibia. In the fall of 1922 the condition had become so bad that the necrotic shaft and the lower epiphysis were simply lifted from the leg being surrounded by a large amount of foul pus. Excellent healing of the wound occurred with regeneration of the upper half but not of the distal half.

It should be stated that there was nothing to do but remove the epiphysis in this case for the entire bone was one necrotic mass. The case is considered to be luetic osteomyelitis. What effect the removal of the epiphysis may have had upon the failure to regenerate completely is a question. Suffice it that the process has been entirely cured and complete function may be secured by a small bone graft.

**CASE 12.** L. F., a white female of 7 years complained of pain over the right tibia. The bone was bowed anteriorly and presented much thickening, but there was no discharge and no fever. A diagnosis of non-suppurating sclerosing osteomyelitis as described by Garre (5) was made. The tuberculin and Wassermann tests were negative and the patient was given antituberculous treatment as a therapeutic test without results. Resection of the entire diaphysis was performed in October 1922. No pus or cavity was found but the bone was very markedly eburnated and the medullary cavity almost obliterated. In December 1924 her doctor reported an entire cure with healing, regeneration and good function.

We would not recommend this treatment for this disease usually for it is found that they are greatly improved by multiple trephining of the cortex but the result in this one case was excellent. Jones (6) gives a review of the literature and describes a case and Bloodgood (2) reports several cases encountered in a relatively short period indicating that it is probably more common than often supposed.

**CASE 13.** J. H., a white male of 7 years entered the hospital first in 1921. The diagnosis was cervical Pott's disease and the patient was placed on a Bradford frame for a year. In November 1922 swelling and pain developed over the head of the left fibula which was resected. He entered the hospital 18 months

later with an abscess of the neck. The fibula at this time was completely regenerated although somewhat deformed. Culture of the abscess revealed staphylococcus albus and the patient was treated with autogenous vaccine. The case is considered to be an infectious osteomyelitis and not Pott's disease as originally diagnosed.

**CASE 14.** A. M., a white male age 40 years was admitted to the psychiatric service, Cleveland City Hospital July 5, 1923 with manic depressive psychosis of suicidal nature. The patient was very depressed and had chronic osteomyelitis of the shaft of the left femur of 9 years duration. Operation in another hospital 3 months previously. Blood and spinal fluid Wassermann negative. Operation Cleveland City Hospital January 4, 1924. Subperiosteal resection of 7 or 8 inches lower end of shaft of left femur above condyles. July 10, 1923 a preoperative X-ray of the lower third of the left femur showed roughening, thickening and a large area of destruction. March 16, 1924 and February 15, 1925 X-rays showed some areas of calcification in the periosteum. March 2, 1925 there was moderate bone regeneration but no union with condyles. March 12, 1925 the patient's condition was poor. He was melancholic and often refused food. Drainage had practically ceased. The patient would not permit a cast splint or other means of support to be applied. We could not secure a permit for amputation. Summary: The temperature was normal or subnormal except for elevation to around 38 degrees C for 2 weeks following resection. The ends have been allowed to come together by removing traction. Union may yet occur or might follow a short bone graft.

**CASE 15.** E. H., a white female entered the hospital in May 1924. She first became ill at the age of 3 and has had a chronically discharging sinus at the lower end of the femur ever since. She has had 9 operations upon the left femur the last 4 months before entrance to the hospital. A resection of 3 1/4 inches of the lower end of the femur was performed followed by an unusually mild reaction. The patient was referred home under the care of the family physician. In April 1925 there was no sinus. The X-ray showed complete regeneration the alignment was very good and there was less than 2 inch shortening (Fig. 12). The patient is walking a little without support.

**CASE 16.** M. B., a colored female age 11 years entered the hospital in August 1924. A year previously she had developed a painful swelling over the left tibia which was incised by a doctor. Since that time she has had no pain but has had a discharging sinus.

Examination shows two sinuses over the left tibia just below the knee. The tibia is thickened and roughened and somewhat larger than the right. The X-ray shows osteomyelitis of the upper half of the tibia. On August 27 a portion of the shaft of the bone extending 4 1/2 inches from the tibial spine was resected. There was one cavity lined with soggy

great effect as the incidence of failure seems to be scattered equally in the various age groups. One would expect poorer bone replacement in adults however.

With a somewhat more judicious selection of cases and some improvements in technique we believe that failure to completely regenerate should not occur in more than 10 per cent of all cases of resection. A cure of the infection should occur in practically every case after one operation. In cases of multiple chronic osteomyelitis some of the foci which one might term secondary appear to be well localized. It is not necessary to resect the shaft to cure such a focus.

In the matter of technique of operation the periosteum should be closed as completely as possible over a drainage tube of medium size.

It is probable that most of the bone formation is by the periosteum which may then deposit layer upon layer about the canal left by the drainage tube the canal being left as a medullary cavity or filling in from the ends by callus formation to be subsequently restored to form a medullary cavity. The amount of the regenerated shaft formed by the endosteum is a matter of argument. It would seem to us that its role is slight.

Nichols' idea of sterilizing the cavity with carbolic and alcohol may be suitable in such cases as he reports in which the resection is done about 10 weeks after the acute process subsides and in which the periosteum is lined with a flexible shell of bone. However to use such drastic antiseptics in the chronic cases would be to destroy the periosteal cells upon which success so much depends. Dakin's solution may be used until the discharge becomes glary, and then replaced by salt solution while the tubes are gradually being withdrawn.

#### CONCLUSION

In properly selected cases of chronic osteomyelitis subperiosteal resection of the diaphysis of long bones coupled with subsequent bone graft if necessary offers a better chance of cure and normal function than the less radical procedures.

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FIG. 13. Case 10. *a* Showing involvement of the bone before operation. *b* Two and one half months after re-

section of 4 1/2 inches of the shaft. *c* Eight months after resection.

had merely been saucerized (Case 3). A second operation upon the bone resected has not been necessary in any of these cases.

There are 7 other cases which we are not including in the report which have been done very recently and are still in supports. There are 4 femora which are regenerating well and 3 tibiae, 2 of which are failing to regenerate.

#### DISCUSSION

A with any procedure it is best to employ some selection of cases to which the remedy is to be applied. Nichols (7) and Clopton (4) have stated that the tibia is a favorable bone for resection because of the adjacent fibula which acts as a splint. Both of these authors had trouble with the tibia although the latter author feels that bone grafting can be effectively resorted to and makes the resection operation quite successful in the event of failure to regenerate. However our experience and that of Beye (1) who reports great misfortune in a group of 5 cases, the four tibiae failing to regenerate and the 1 femur developing a shortening of 3 inches makes us hesitate to recommend resection of the tibia except in cases of necessity, when anything less radical will not

remove infected bone. In these if regeneration is incomplete a bone graft may be inserted with good prospects of a useful leg. In many cases of osteomyelitis of the tibia one or both ends are involved with a section in the middle which appears more or less normal in the X rays. It is possible that this central section could be saved making necessary the filling in only of the short section at either end. This was tried in a recent case not included in this report and is offered merely as a suggestion. The femur on the other hand has great powers of regeneration and if persistent and sufficient traction is applied the shortening need not be great. It is interesting that Simmons (9) should state that resection of the femur is impossible.

The reason for the failure of some of the bones to be replaced probably lies in the relatively deficient blood supply of the tibia and the bones of the forearm and the constant regeneration of the femur is probably explained by its rich blood supply. We have made no study of the calcium metabolism of our cases and it is possible that such a study might throw some light on the failure to produce new bone. Age apparently has no



Fig. 1. Gross specimen. Shows tumor anterior to sacrum, pedicle replacing the third sacral vertebra and firm attachment to the anterior aspect of the spinal cord.

chamber anterior and above the enteric opening of the neurenteric canal. This leaves a portion of gut wall back of the anus which is known as the postanal gut. Most of these vestiges atrophy but it is logical to believe that they may persist in part or entirely and at any time during life give rise to definite pathological problems.

Mallory (6) reviewed the embryology with reference to the closure of the neural tube. He studied 7 human embryos for vestiges of this event and reported clinical cases with pathological conditions in this region which he thought were best explained on this embryological basis. He found a residue of tissue that contained epithelial and neural elements in 6 of the 7 embryos examined. The pathological

tissue removed from the clinical cases showed cells of neural origin and neuroglia fibrils. He said nothing of the neurenteric canal or possible pathological conditions associated with the filum terminale. Middledorpf (7) in a report of pathology found in this region reviewed the embryology in search of an explanation for tumors between the rectum and sacrum. He concluded that they were best explained as arising from remnants of the postanal gut. He did not mention the possibility that tumors found within the vertebral canal in the region of the cauda equina had a similar etiology. Borst (1) discussed the other theories postulated to explain the varied and complex pathology found here. They are all abstract, hard to comprehend and difficult

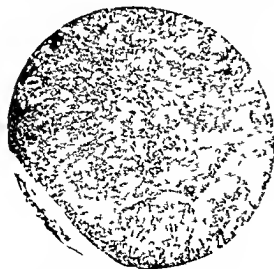


Fig. 2. Low power of pedicle. Showing tendency toward cord replacement.

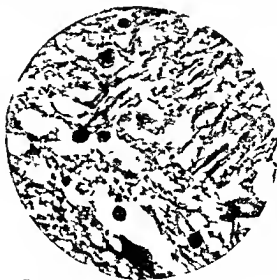


Fig. 3. Oil immersion (X800). Showing glia cells and glia fibrils.

## A CONGENITAL CYSTIC TUMOR OF THE NEURENTERIC CANAL WITH SPECIAL REFERENCE TO ITS HISTOLOGY AND PATHOLOGICAL SIGNIFICANCE

By G. H. HANSMANN, M.D., IOWA CITY, IOWA

From the Pathologic Laboratory of University Hospital

Of all the pathological conditions encountered between the rectum and sacrum tumors are to me the most puzzling. I include in this class the intradural and extradural tumors situated between the conus medullaris and coccyx. The disturbing features are the number of tissues found in a single tumor, the histologically malignant tissue encountered and the inability to predict accurately in the absence of a well grounded explanation for the origin of the condition what will happen when a given tumor is apparently removed. The case reported shows what may happen along the course of the neurenteric canal and the facts involved will serve as a basis of a conception of most of the pathological conditions found in this region.

**Case report.** Path. No. A 24 12. House No. 60400. Clinical history. The patient was a female infant 1 day old brought into the hospital December 27, 1923, to have a harelip and cleft palate repaired. Operation was attempted January 16, 1924. During the operation the child became very cyanotic and operation was discontinued. She died the following day at 1:43 p.m. of bronchopneumonia.

**Necropsy findings.** The body is well developed and well nourished. Weight 2,801 grams. Skin is cyanosed. There is a cleft palate and double harelip and a congenital coloboma of each eye with elongation of each pupil toward the nasal cavity. The lower portion of the right lung is consolidated. The right lung receives two primary bronchi. The heart shows both great arteries arising from the right heart, a patent ductus arteriosus, patent foramen ovale and imperfect interventricular septum. The aorta arises to the right of the pulmonary artery and is separated from it by a wedge shaped piece of muscle. The cæcum is directly beneath the liver and has a mesentery. The kidneys show ununited tubules forming what might be termed polycystic kidneys. There is a double vagina and uterus.

The lower lumbar vertebrae and the sacrum are removed *en masse*. This is done because in the pelvis a mass measuring 6 centimeters in diameter is attached to a defect in the anterior surface of the sacrum by a pedicle about twice the size of a lead pencil. The vertebrae are then split and the accompanying photograph illustrates the pathology better

than any description can. The third sacral vertebra is gone and the congenital cystic tumor passes into the bony canal at this level and is attached firmly to the anterior surface of the cord. The tumor is cystic and many of the cysts contain mucus. The relative size and position of the cysts can be made out in the photograph.

**Histological report.** The tumor presents the only interesting histological finding. The pedicle shows dense glia fibrils and resting glia cells. In the glia tissue are a few cells that appear to be ganglion cells but they do not stain well and cannot be definitely identified. There is also a small canal lined by ependyma. A little nearer the sacrum there are cells and arrangements of cells which at once suggest the tumors arising from this region diagnosed as ependymal gliomata. The cysts contain columnar epithelial lining and the surrounding more solid tissue shows stratified squamous epithelium. Most of these findings are shown in the accompanying photomicrographs. In addition the tissue contains a collection of lymphoid cells, fat, a few small islands of cartilage, some smooth muscle, myxomatous appearing fibrous tissue, nerves and quite large blood vessels. The phosphotungstic acid hæmatoxylin stain shows that the cells having the arrangement of the so called ependymal glioma tumors produce abundant glia fibrils. At the point of junction with the cord the structure resembles closely that of a gloved spinal cord except that the horns are not formed. The position of the blood vessels, the glia in parallel arrangement, the so-called replacement gliosis together with the shape and size of the pedicle and even the small canal lined by ependyma are all reminiscent of a spinal cord.

At the beginning of the third month of embryonic life the neural tube extends the full length of the neural canal and is in close relationship with the deep layers of the skin. The bony canal grows rapidly, the cord fixed above is drawn away from the coccyx, the atrophied caudal extremity forms the filum terminale. The skin connection is evidenced by the crural ligament and in certain cases by a postanal dimple or sinus. During early embryonic life there is a communication around the caudal extremity of the notocord between the central canal of the cord and the alimentary canal. The proctodæum or primitive anus invaginates and joins the cloacal

Age	Sex	Symptom	Location	I t d l	E t d l	Ante h d t d	Defect	Diagnosis
9	F	2 1/2 yrs	1 D 4L	+	?	?	?	Glioma
16	M	1 yr	1 D 3L		+	N	?	Cerebroma
4	M	5 mos	5S		+	N	?	Glioma
31	M	8 yr	1L-3L	+		C	?	Glioma
3	F	1 1/2 yr	11D 5L	+		C	?	Ependymoglioma
5	F	1 1/2 yrs	3L to 1S	+		N	1 s	Ependymoglioma
27	M	5 yrs	1 D S	+		?	?	Ependymoglioma
4	M	8 yr	L-4th L	+		Ca	?	Ectotheliosis
1	F	1 1/2 yr	1S 4L	+		C	?	Ectotheliosis
3	M	?	L S	+		Co s	?	Ectotheliosis
47	M	1 yr	L	+		?	?	Adenoma
	F	yr	C d	+		?	1	Ependymoglioma
38	F	9 yrs	Ca d	+		?	?	Nerveoma
48	M	6 yr	C d	+		?	?	Sarcoma
?	?	5 yrs	C d	+		?	?	Ependymoglioma

Each case reviewed however indicates that the tumor arose from the neurenteric canal. Hundling's (4) review of tumors between the rectum and sacrum is quite complete. He inclines toward the embryological explanation. The names applied to these tumors are confusing. Most of them are designated as teratomata but the names found for the remaining tumors form a lengthy list. Every tumor found even those spoken of by composite names such as chondromyxolymphadenosarcoma might well have had their origin in a tissue residue of the neurenteric canal. Hundling noted that these tumors tended to invade the sacrum indicating that the growth infiltrated along the course of this structure. These facts indicate that the neurenteric canal is responsible for many abnormalities found along its course.

The behavior of these tumors is interesting. They remain quiescent for years and then frequently start to grow with rapidity. They may be encapsulated or invasive. Although they have histological appearances that permit of almost any diagnosis depending on rapidity of growth and type of tissue proliferation, these tumors have not been known to metastasize. This recalls other tumors attributed to fetal residues as adamantinomatous odontomatous Rathke pouch tumors, etc.

The tumors in the pelvis can be determined by rectal and proctoscopic examina-

tions. An anterior defect in the sacrum if present is demonstrable. Tumors of the cauda equina are harder to diagnose. Often patients go from physician to physician with no other trouble but pain in the lower extremities. Such a case unless explored may remain undiagnosed for 25 years. When rapid growth begins signs and symptoms are progressive according to the rapidity of growth. Surgery has given the best results. Many times the extent of the tumor cannot be made out before operation. It is at times impossible to remove the tumor intact. If this cannot be done the benign nature of the tumor permits piecemeal removal without the fear of soiling. These procedures have been followed by X-ray and radium with very indefinite results from this part of the treatment.

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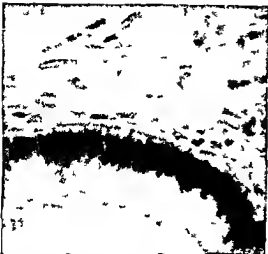


Fig 4 High dry ( $\times 200$ ) Showing cyst lined by hi, h columnar epithelium



Fig 5 Hi, h dry ( $\times 200$ ) of tissue resembling the arrangement of ependymal glioma tumors of this region.

to remember Keen and Coplin (5) reported a case in a child aged 2 who had a fistula passing through the sacrum and connecting the rectum with the skin over a congenital tumor on the posterior aspect of the sacrum. The anatomy of the tract was not worked out but we are inclined to assume that both the neurenteric canal and distal portion of the neural tube remained patent and that the

opening over the sacrum corresponded to the opening of a sinus in some of the embryos studied by Mallory. Accordingly the origin of tumors over the sacrum has been well explained the origin of those arising between the rectum and sacrum has been suggested but no attempt has been made to explain the peculiar tumors found in the spinal canal between the conus medullaris and the coccyx.

It is important to compare the condition found to the histology of tissue from the canal and to determine whether or not this pathology is located in the course of the canal. The cases from three (2, 3, 8) important papers are brought together in a table to show the relationship of intradural and extradural tumors situated between the conus and coccyx and this congenital structure.

The tumors tabulated all lay in the course of the canal and in 1 case perforated the sacrum anteriorly and in another connected with a cyst in the pelvis through an anterior defect in the sacrum. The tumors compiled in the table are histologically similar to our case. It is recognized that tissue in the filum terminale might give rise to similar growths and therefore the tumors arising from congenital remnants in this region do not necessarily originate in the neurenteric canal.

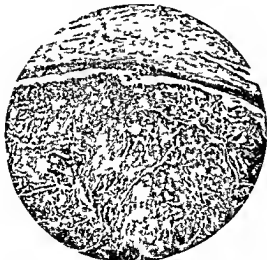


Fig 6 Low power ( $\times 80$ ) of cyst lined by stratified squamous epithelium. Cyst is filled with detached epithelial cells



Fig 3 If the retraction is limited to the lip and lower part of the nose it is not practicable to correct it by the implantation of either bone or cartilage unless one is willing to chisel away the prominence of the bridge before inserting the implant

A young woman with a well developed nasal bridge in whom the retraction was limited to the tissues bordering the anterior nares. In this case as in the immediately preceding one the columella was very short the anterior portion of each ala recurring backward to join it. The mesial crus of the lower lateral cartilage appeared to extend into the substance of the upper lip. In this type of case much improvement can be obtained by stepping forward the cheeks upper lip and lower part of the nose. This is done by freeing the lip and ala with the adjacent parts of the cheeks from the maxilla through an incision in the upper fornix which extends from one first molar tooth to its opposite fellow. This is continued up into the nose and forward along the lower border of the septum. The cheeks and lip can now be sutured in a forward position on the maxilla which will correct the retraction about the anterior nares and the columella can be stepped forward on the lower border of the septum which will give a forward tilt to the tip of the nose. The hemorrhage following the freeing of these tissues is quite sharp and we have controlled it by gauze packing and maybe 10 minutes of finger pressure before attempting to suture. Just before suturing a curved semisharp elevator is passed between the skin of the dorsum and the cartilaginous bony framework of the nose. In one case of this kind to give greater mobility the writer made a circumferential division of the lining skin of the vestibule which was followed by a stricture. This subsequently required an intranasal skin graft for its relief.

Fig 3 a and c. A case which was treated in the manner described under Figure 3. In this particular instance a vertical wedge of tissue was removed from the under surface of the middle part of the lip which allowed the skin to fold forward to compensate for the shortness of the columella.

Fig 3 b. Tracings made from the negatives of photographs a and c show how much was accomplished. A photograph sent by the patient 1 year later shows no appreciable recurrence of the retraction.

B Those due to a loss of bony foundation of the lip nose or both from trauma or disease.

C Those in which the retraction has followed repair of a single or double congenital cleft of the lip and palate.



Fig 4 a b and c. The same type as that shown in Figure 3 but more pronounced. The same type of operation was used in both cases.

Fig 5 Superimposed tracings of a case similar to that shown in Figure 3. In this case two pieces each 3 centimeters long taken one from the 8th and one from the 9th right costal cartilage were inserted in a tract made just in front of the maxillary bone between the floor of the vestibule and the mucosa of the upper fornix. An external incision was made on each side in the ala labial fold which was immediately sutured.

This was not considered sufficient improvement and the operation described under Figure 3 a and b was subsequently done in addition.



Among those of the first group the lack of maxillary prominence is most marked about the lower and lateral boundaries of the anterior nares and is accompanied by an anteroposterior shortening of the septum. The whole maxilla may be contracted in size but in many instances the palate and alveolar process are absolutely normal in size and in their relations to the mandible.

Heredity or the atavism will no doubt account for many of the cases that would fall in the first group. In some the mucous lining of the nasal passages is markedly shortened from before backward which has suggested the thought that possibly early inflammations and scarring of this mucosa from infantile snuffles or other infections may have had a causative influence.

Besides direct trauma and ulceration the judicious use of radium was the cause in 1 case included in Group B.

Following a repair of a congenital cleft of the lip and palate there may be considerable retrac-



# DEPARTMENT OF TECHNIQUE

## THE PROBLEM OF BRINGING FORWARD THE RETRACTED UPPER LIP AND NOSE<sup>1</sup>

By V. P. BLAIR, M.D., F.A.C.S., St. Louis, MISSOURI

**R**ETRACTION of that part of the maxilla which forms the foundation of the cartilaginous nose and related part of the upper lip may cause changes in the human face that may vary from not pleasing to hideous de-

formity. The abnormality is more evident when viewed in profile.

The cases observed by the writer have fallen into the following etiological groups:

A. Those of apparently natural occurrence



Fig. 1 a. A young girl who originally had a saddle nose in conjunction with a moderate amount of flattening of the maxillary bone in the neighborhood of the anterior nares and proportionate anteroposterior shortening of the septum. She had been previously treated by the implantations of cartilage into the upper part of the dorsum which accounts for the prominence of the bridge.

Fig. 1 b. The result of the implantation of a triangular shaped piece of the right eighth costal cartilage through an incision within the nostril after removing one of the original transplants. At a later operation another strip of cartilage was implanted upon this triangular piece to raise the tip further. By these operations the dorsum, the alae and tip of the nose, the cheeks and upper lip have been brought forward. The amount of this forward movement is more easily seen in Figure 1 c.

Fig. 1 c. Superimposed tracings made from profile negatives taken when the girl first came to us and after the completion of our second operation. This is a somewhat simple but usually not the most satisfactory plan of treating such cases. If there is much strain the cartilage is apt to bend and we have had to remove it in 2 cases. Bone is more rigid but if rib is used it may not give sufficient body. (See Fig. 2 a.)



Fig. 2 a. If in a case similar to that presented under Figure 1 the attempted correction is made by the insert on of a straight piece of bone such as might be obtained from a rib, less some plan is adopted to hold forward the lower end of the graft until bony union occurs, the tip of the nose will still lack prominence. This illustrates such a condition with a rib graft solidly united to the dorsal surface of the bony bridge.

Fig. 2 b. The result shown was obtained by incising the columella by means of a strip slid from the central part of the lip and at the same time chiseling the nasal bones free from their attachments to the maxillary and frontal bones and the nasal septum. The nose was then pushed forward and held in a more desirable position until union occurred. This was done by means of a metal bar which had a dental anchorage below and passed up into the right nostril between the lip and the maxillary bone. This complicated and not overly satisfactory spint was merely contrived by Dr. J. A. Brown, DDS, to meet the patient's objection to the long detention from his business that an external spint would have caused. The latter would have given greater final prominence to the tip of the nose. Figure 2 b does not do full justice to the result because it is not a true profile.

<sup>1</sup> From the St. Louis Department of Plastic Surgery, St. Louis Children's Hospital, St. Louis, Mo. Received for publication, December 6, 1934. Addressed to the American Laryngological Association, May 6, 1935.

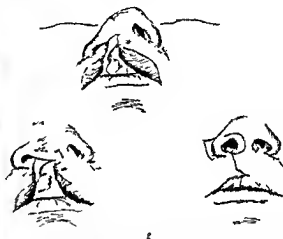


Fig 8 a b c d e f and g If a single bare lip remains unoperated upon for some years or if the operation does not establish a proper relation between the base of the columella and the alar in the affected side then with growth there will develop a characteristic variation which consists

primarily of a unilateral retraction of the lip and nose and when pronounced can be satisfactorily relieved only by stepping forward the lip cheek and columella of the affected side. This necessitates the splitting of the columella in the midline and usually the removal of a V under the lip to allow one half the columella to be stepped forward.

Fig 8 a and b show the front and side views of such a case before and after operation and Figure 8 g shows the plan of the operation

Fig 9 If there is much retraction of the anterior part of the maxilla the lip may have to be held forward either by orthodontic treatment or by a prosthesis. This shows the result of a previous correction after the loss of the anterior one-half of the palate and alveolar processes of the maxilla and part of the upper lip from trauma. The lip is adherent to the bone. The later treatment of the case consisted in first freeing the lip from the maxilla to well above the attachment of the alar and lining the new sulcus with Thiersch grafts. This required two operations. Later a full thickness triangular flap was turned from the lower into the upper lip at the site of the greatest loss.

Fig 9 b Shows the result of these operations before insertion of the prosthesis



Fig 9 c Shows patient's appearance when wearing an upper dental plate which is so planned as to compensate for the lost part of the maxilla

to bring the nose forward. In some cases the external nose was so small that it was necessary

to piece out the covering as well as the lining in order to obtain a desirable result



Fig 6 When the foundations as well as the upper lip and nose have been destroyed much can be gained by transplanting the cheeks forward after the plan described under Figure 4 before attempting to build the lip and nose.

Fig 6 a Profile of a man who had a number of years previously lost from an ulceration the whole nose part of his cheeks and lip and the anterior half of the palate and alveolar processes of the maxilla.

Fig 6 b The result obtained by freeing the cheeks and suturing them forward.

Fig 6 c Final result after the nose and lip were made from a bald scalp flap and a cartilage was implanted into the bridge.

tion which will vary with the type of repair employed. Usually it is most pronounced in the alveolar part permitting a backward displacement of the upper lip with or without some snubbing of the nose but in cases in which a V has been cut from the lower free border of the septum to



Fig 7 a A common deformity that may follow a bilateral operation in which the premaxilla was moved back is a lateral spreading of the nostrils and extremely short columella and snubbed nose.

Fig 7 b a c Shows such a case treated after the plan detailed under Figure 3 plus the addition of a diamond shaped piece of skin and subcutaneous tissue from the base of the columella and upper part of the lip.

move back the premaxilla the nasal snubbing may be the most noticeable feature.

The common characteristic of these cases is a receding upper lip or the tip of the nose or both but the abnormal anatomy producing this retraction varies in different cases both in kind and degree and must be considered in seeking the most appropriate plan of correction in each instance. In general there are two surgical plans applicable to the correction of this condition, one is to build out the deficient maxillary foundation thus pushing forward the retracted soft tissues the other is to draw them forward and fix them in this position. A combination of these two plans will often give the best results.

The retracted maxilla may be built out or supplemented in a number of ways.

Orthodontic treatment will give very great help in some cases when they are seen early.

We have used the following plans to build up the bone about the orifice of the anterior nares: the implantation of cartilage, the use of a dental prosthesis after the soft tissues have been liberated from the periosteum of the maxillary bone and the sulcus has been lined with Thiersch grafts; the cheeks have been liberated from the maxilla and sutured in a forward position and the lining of the nasal tube has been lengthened with a flap from the forehead, arm or the mucosa of the mouth. The soft tissues have been drawn forward and suspended in this position either by the implantation of cartilage or bone between the skin and framework of the dorsum of the nose or by suturing the liberated columella in a forward position on the lower border of the septum.

There is a type of retracted nose in which the septum and the columella are both short part of the cartilage of the latter being buried in the lip. The columella is also short in the complete double congenital cleft of lip and palate. In these cases the columella will have to be lengthened in order



Fig 7 d The diamond shaped piece of skin and subcutaneous tissue added in the base of the columella and upper part of the lip. The latter step decreased the epibulbar angle. The extremely long lip will be shortened at a subsequent operation.

FRACTURES OF THE OS CALCIS<sup>1</sup>

BA L IRVING CONDIT M D F A C S DETROIT MICHIGAN

THIS is a short review of 15 cases observed during a period of 24 months from January 1922 to January 1924 with the object of determining a definite period of disability.

Fractures of the os calcis are an unusual injury in a general practice. They are unusual in any form of employment except the building trades but comprise about 1 per cent of all fractures in this line of work.

These fractures are almost invariably caused by a fall or by landing on the feet. When there are no other fractures they are usually confined to falls of not over 10 feet. If the fall is greater they are complicated by fractures of the long bones above and severe injuries to the ankle joint itself.

The forms of fracture are varied. They may be and rather commonly are comminuted. There are 7 cases of this series that had more than one fracture line, 5 cases with one line and 3 compound cases, 1 of which was comminuted and 2 not. The axis of the posterior portion is lengthened laterally as a result of compression. The arch of the foot is disturbed and a flat foot results causing severe disability particularly to the carpenter or laborer in whom this fracture commonly occurs.

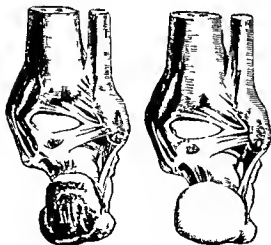


FIG 1 (left) Normal outline of os calcis posterior view  
FIG 2 Same view as that in Figure 1 showing flattened aspect

The diagnosis should of course be made by X ray but there are clinical signs that should always be looked for as follows.

First there is swelling and thickening posterior to the mediotalar joint on both the internal and external surfaces. Second thickening occurs below the external malleolus. Third there is no disturbance in flexion or extension of the ankle joint but there is marked limitation of lateral motion that is pronation and supination. Fourth in taking the X ray picture it is very important to get a projection through the bone from above downward to show the amount of disturbance in the lateral diameter.

## TREATMENT

Nine of these cases were treated by open operation. The open operation in 5 of the 9 was a tenotomy (complete) of the tendo achillis. A small incision was then made directly above the posterior portion of the os calcis on both sides. A heavy round instrument was passed through above the bone and this portion brought down. This was done quite easily after the tendo achillis had been severed. In these 5 cases there was an avulsion of the posterior portion of the bone which had been pulled up by the tension of the tendo achillis.

The impaction which is almost invariable in all fractures of os calcis was then taken out by placing the posterior portion of the bone just under the malleolus over a sandbag and striking the other side with a heavy padded mallet. A roller bandage was placed on either side just under the malleoli as noted in the operation. This was done on both sides. In the other 4 cases it was necessary to make a larger incision and replace the fragments. In 2 cases chromic catgut was used to hold the fragments. Of the 6 cases not operated on 4 were treated by the sandbag and mallet method in the last 2 nothing being done but the usual immobilization. In all 9 cases the dressing was a pad or roller bandage on the arch with the foot in hyperextension and a plaster cast. The time of having the cast on varied somewhat but in the average case it was left on 3 weeks. It was then removed daily or every other day, and passive and active motion begun. The cast was removed entirely in 5 to 6 weeks.

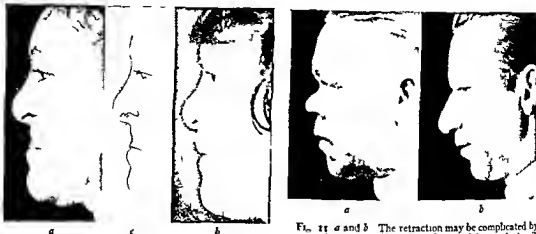


Fig 10 a Shows a woman who had been operated upon in early childhood for a complete congenital cleft of the lip and palate. There is a loss of the premaxillary bone and the lip is very thin, much scarred and bound down to the maxilla. The first step in the treatment was to liberate the lip base of columella and alar by incision and Thiersch graft as described in Figure 9. Next the whole outer surface of the lip was replaced with a flap from the forehead giving the result shown in Figure 10 b.

Fig 10 c Shows tracings for comparison. Note how much the alar septolabial angle and the lip have been brought forward but the tip of the nose has been moved very little. The case could still be improved very materially by transplanting the columella forward in the septum with corresponding forward movement of the tip. The new lip is still thick from recent operation.

Fig 11 a and b The retraction may be complicated by a very short mucous lining of the nasal fossa which will have to be lengthened before the tip of the nose can be brought forward. This was accomplished by picking out the covering as well as the lining. After freeing the soft parts of the nose from the maxilla and nasal bones through a crescent incision across the bridge which completely divided the septum and the lining mucosa, the nose was drawn forward and the gap in the lining was picked out by means of a forehead flap let in through the external incision. After this tissue had healed in place, the pedicle was cut and part of the remaining flap was used to lengthen the external surface of the nose.

Fig 12 a In this case the soft parts were freed from the bones through an incision in the upper labial fornix and the cut mucous lining was picked out by means of a flap from the arm let in through an incision in the upper fornix.



Fig 12 b The final result obtained by this operation and the subsequent implantation of a rib cartilage into the dorsum.

Fig 12 c The condition immediately after the first operation was completed and the pedicle of the flap returned to the arm.

## A NEW BLOOD TRANSFUSION APPARATUS

By DANIEL McLELLAN M.D. C.M. B.A. VANCOUVER B.C.

THE following is a description with illustration of an apparatus for the direct transfusion of blood with the introduction of citrate and saline solution into the blood stream as it passes through the apparatus and there are also a few points on its use.

An all glass 30 cubic centimeter syringe is attached by means of a suitable adapter and rubber tubing to the stem of a Y shaped glass tube. By means of rubber tubing the intake arm of the Y tube is connected with the donor needle the exit arm with the recipient needle.

On each side of and a short distance from the Y tube is placed a cone shaped glass valve the one on the donor side with the apex pointing toward the donor the one on the recipient side with the base facing the recipient.

At a point midway between the donor needle and the glass valve nearest the donor a second Y shaped glass tube is placed to the stem of which a rubber tube 20 inches long is attached the upper end connecting with a 300 cubic centimeter burette for citrate and saline solution. On this tube are placed a Murphy screw clamp by which the flow can be regulated down to a drop and a cut-off clamp by which the flow can be completely cut off as desired.

The needles are 15 gauge preferably gold. A small particle of erosion in a needle is a focus for clot. Gold does not rust. The needles are attached direct to the rubber tubing. Every joint possible should be eliminated.

## POSITION OF PATIENTS

This is important. Tables should be placed in the form of an L or L reversed or a T the recipient's table forming the foot of the L or the cross of the T. With the donor's arm slightly out ward but in a general way parallel to his side and the recipient's arm stretched out at right angles to his own body the two arms are in the correct position for the insertion of the donor needle toward the finger tips and the recipient needle toward the heart.

A standard with a goose neck attachment capable of being easily raised or lowered stands in the angle formed by the two tables and is out of the way of the small dressing table. From this goose neck hangs the burette.

The proportion of sodium citrate solution to normal saline is a matter which can be decided

by the operator. By using a mixture of 2 ounces of a 3 per cent solution of sodium citrate with 18 ounces of normal saline solution and allowing enough of this mixture to come through in drops it will be found that even less than one third the usual amount of citrate is necessary. In fact when smaller quantities of blood are being transferred say 6 to 10 ounces as in children once the first stroke of the syringe is made the citrate saline solution may be cut off altogether.

## EXPELLING AIR FROM THE APPARATUS

Clamp off the long tube. Fill the burette with warm citrate saline solution. Screw down the Murphy clamp to allow a moderate flow. Immerse the needles in a bowl of citrate saline solution. Release the cut off. A few strokes of the syringe will expel the air. The last bubble may be expelled by inverting the syringe. The automatic action of the valves may here be observed. As





Fig 3



Fig 4

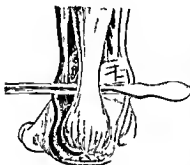


Fig 5



Fig 6

Fig 3 Lateral view

Fig 4 Same view as that in Figure 3 showing flattened arch in type of fracture with complete avulsion of posterior fragment

Fig 5 Posterior view showing position of metal instrument used to pull down on after tenotomy

Fig 6 Lateral view showing position of sound anterior to tendo achillis



Fig 7 Schematic drawing showing position of roller bandages used to protect soft parts when the impact of the os calcis is being taken out

#### PROGNOSIS

There has always been considerable difference of opinion regarding the period of disability in fractures of the os calcis. We must consider the type of man and the work he does. The disability in these cases is not based on the statements of the patients but on the period covered by compensation and the actual date of return to work. This was secured from the compensation records.

Of the 9 cases operated on the shortest period of disability was 7 weeks the longest 19 weeks. Of the 6 cases not operated on the shortest period was 12 months. One case was that of an old luteic negro 65 years of age with a congenital flat foot. The other was a case of bilateral fracture one of which was severely comminuted and compound.

## EDITORIALS

### SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN M.D.  
ALLEN B. KANAHEL M.D.

Managing Editor  
Associate Editor

WILLIAM J. MAYO M.D.

Chief of Editorial Staff

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#### THE HARD LOT OF THE CANCER PATIENT

THE lot of the cancer patient receiving the best possible treatment that can be offered is unenviable. The lot of the cancer patient who by neglecting treatment experiences the normal inevitably fatal and loathsome course of cancer is hard enough. The lot of the cancer patient who nearing his end of torture in sad retrospect learns that his disease could have been cured by relatively simple measures and that he has been deluded by false prophets and false theories until his case is hopeless and his family penniless is indeed pathetic.

Our problem as physicians is to make easier the lot of the cancer patient. The promulgation by accredited physicians of half-baked theories and pseudo scientific work adds to his difficulties.

The American Medical Association, the American College of Surgeons and the American Society for the Control of Cancer, have done much to educate the public. This education forms a good psychological background but the individual who has cancer demands action. To discuss theories with the cancer

patient is to jest with him. The only question which seriously interests him is, "What can be done for me?" When a patient is told by a responsible physician that he has cancer, he is dazed, terror stricken and feels hopeless. Any chance for escape is seized upon. The more positive the promise of cure, the more enticing is the prospect. With avidity, he reads in metropolitan magazines the announcement of an electrical instrument by which its possessor can from one drop of blood discover and locate cancer and with a similar device can effect its cure. A fitting climax is reached when, during a meeting of the American Medical Association, he observes a picture of the originator (a regularly licensed physician) occupying a full page of a great newspaper and bearing the significant caption, 'Our Most Distinguished Citizen.'

Other front page newspaper articles quoting recognized medical authorities announce a new development by which X rays are made to converge in the deeper parts of the body and destroy a deep cancer without injury to intervening or adjacent tissues. The inference is that surgery is needless, radium out of date, deep X ray the final word. Again to the utter confusion of the cancer patient, his morning paper states that a great newspaper "will announce tomorrow" the details of the discovery of the germ of cancer along with a serum for immunization and cure. A few days later he reads in many daily papers the announcement that the scientist himself has read a paper at a medical meeting at which lawyers, newspaper men and others took part and the address was of a character to inspire in blazing headlines such terms as "Germs



the piston is drawn up the valve in the intake arm opens allowing fluid (blood) to be drawn up into the syringe and as the piston is pushed down the valve closes preventing the passage of fluid backward through the needle. As the piston is pushed down the valve in the exit arm opens and fluid (blood) is allowed to pass through the valve into the vein of the recipient and as the piston is drawn up the valve closes preventing blood being drawn back from the recipient.

#### REGULATING THE FLOW OF CITRATE SALINE SOLUTION

Place a suitable clamp (dayspring pinchcock) on the rubber tube between the Y tube (burette) and the valve nearest to it. Screw down the Murphy clamp tight. Release the cut-off clamp. Unscrew the Murphy clamp until the solution comes from the needle in drops about 100 to the minute. Close the cut off clamp until you are ready. Take off the pinchcock and place it on the tube between the Y tube (burette) and the donor needle. The clamp could be placed here at first but in regulating the flow you would need to see that the syringe piston is not forced out by pressure of fluid so that you are given a wrong conception of the rate of flow.

#### TOURNIQUETS

Any suitable tourniquet may be used but I find that the old Army screw tourniquet with the

block removed is excellent. You can release it in a second without disturbing the arm and in the case of the donor it can be loosened or re applied at will. I think it is a mistake to have your donor lying down too long before operation. Let him move around until the last minute and you will get a much better flow.

#### INSERTING THE NEEDLES

Insert the recipient needle first. Immediately loosen the tourniquet and release the cut-off clamp on the burette tube. The liquid begins to flow through the apparatus into the recipient slowly but fast enough to keep the fluid in motion and gives no chance whatever for the formation of clot.

This bridges over that bane of direct transfusions that space of time sometimes short but unfortunately sometimes longer between the insertion of the recipient and donor needles. See that the syringe piston is kept pressed home at this stage as it may be forced out by the solution.

Insert the donor needle. Remove the pinchcock and proceed by steady easy strokes to pump the blood from the donor to the recipient. Count the strokes. By the simple deduction of the quantity of citrate saline solution from the total you will get the actual quantity of blood transfused.

Time and experience will decide which size of syringe is best to use with this apparatus whether a 30 cubic centimeter, a 20 or a 10.

irritation, producing dense, fibrous connective tissue which cuts off nutrition from the cancer cell and encapsulates it. In surface cancers of low malignancy, diathermy, possibly best exemplified by Wyeth's endotherm is the agent of choice.

The pathologist skilled by study and experience in immediate microscopic section diagnosis becomes a keystone. From the microscopic section, he may prognosticate the future and also determine the best form of treatment in a given case. The surgeon with his knife makes possible the work of the pathologist and with his knife subsequently cures the great majority of curable cancers. Carpenters, plumbers and masons are all required in the building of a great structure. The engineer has the perspective and apportions the work to the various technicians. The trained surgeon is the engineer in the treatment of cancer.

According to W. J. Mayo when the cancer has not extended beyond the primary focus, more than 72 per cent of patients are cured. If cancer cells have left the primary focus only 19 per cent are cured. As there seems little prospect of marked immediate improvement in the treatment of cancer except by earlier diagnosis our next great duty is to instruct the potential cancer patient in terms which he can understand so that he may more promptly seek relief. The following statement though incomplete seems adequate for the layman.

A cancer or malignant tumor is a growing mass of non-functioning cells capable of growth and reproduction in the same form after transplantation to a distant organ or part of the body. This movement takes place through lymphatic vessels in which are placed filters—lymphatic glands. Beyond these filters the lymphatic vessels empty their contents into the blood stream. A cancer cell

originating from a growth in a given organ and having broken into a lymph vessel floats onward and is caught in a filter. Here it forms another cancer of the same type. Some of these cells break away, float on further and may be caught in still another filter. Finally, having passed the last filter the cancer cell enters the blood stream which circulates in all parts of the body. At certain places such as in bones, the lungs, kidneys, liver etc., the blood passes through small vessels where the large cancer cell is lodged and begins its growth and the formation of a new cancer out of reach of any form of treatment. A cancer, before a single cell has left its original location is curable by any destructive means whatsoever including the knife, cautery, caustic or what not. If one cell has left the original growth and has become lodged in a distant filter removal of the original growth alone does not cure. The cell in the filter soon forms a new cancer. This has usually occurred when the cancer has been discovered but if the filters—lymphatic glands—containing the cancer cells are removed with the primary growth the cancer is cured. If one cell has escaped through the last filter into the blood stream the case is hopeless. Therefore cancer becomes the greatest of emergencies for no one knows the day or the minute a cancer cell has reached or will reach the blood stream. It therefore naturally follows that the best treatment of cancer is accomplished by surgery based upon accurate anatomical knowledge and consists in the removal of the primary growth and also the lymphatic vessels and glands intervening between the growth and the entrance of the lymphatic vessels to the blood stream. When removal is not practical or is incomplete, radiotherapy is the only remaining remedy.

In these days of publicity and commercialism, it is well to be prepared to differen-

of Cancer Isolated is Claimed, "Cancer Serum Seeming Cure," "New Era Opens to Science," "Description of Great Discovery Given," Experiments for Inoculation and Immunization Are Declared Complete and Effective in Results. His complete overwhelming is achieved when deep down in the conglomerate mass of newspaper publicity he identifies in various parts of the country exclusive cancer serum agencies manned by highly reputable physicians.

It has been the hope of the profession that a causative parasite of cancer might be discovered. Waves of enthusiasm have come and gone. Large sums of money have been expended in the effort. Many false alarms have been sounded. A great effort to isolate the parasite is now in progress. Several rival claims are in. Let us assume that the parasite has been discovered. How will it benefit the cancer patient? Immunizing vaccines and curative sera have been developed only in those self limiting diseases in which an attack immunizes against future attacks. The germ of tuberculosis was discovered more than 40 years ago. Tuberculin was developed. Yet it neither immunizes nor cures. The spirochete of syphilis was discovered more than 20 years ago. Yet no immunizing vaccine or curative serum has been found. Cancer is not self immunizing. Therefore an immunizing or curative cancer serum must be the product of a new principle in science. The discovery of a cancer parasite might lead to avoidance of the source of infection. It is possible that a diagnostic test might result. There is little reason to hope for more. The discovery would probably not materially change treatment.

We can now offer the cancer patient much encouragement without resort to speculation. Broders' cytological classification, founded on MacCarty's study of the individual cancer cell, has done more to clarify the cancer ques-

tion for rational treatment than any contribution in recent years. By studying a large number of squamous cell cancerous growths with the corresponding histories and follow up records and dividing them into four classes to be used as an index of malignancy he found that in Class I in which 25 per cent of the cells were embryonic and undifferentiated 92 per cent of good results were obtained in Class II, with 50 per cent of embryonic cells 62 per cent of good results in Class III with 75 per cent of embryonic cells 25 per cent of good results, in Class IV with 100 per cent of embryonic cells 10 per cent of good results were obtained. The Mayo Clinic working on this basis has shown why certain cancers should be treated with radiotherapy while others do best with surgery. Radiotherapy destroys undifferentiated embryonic cells much more easily than normal cells.

In the average case of cancer of the cervix there is a large percentage of undifferentiated cells. Surrounding the cervix in close proximity are the ureters, bladder and rectum. Cancer cells emanating from the cervix at a very early stage so distribute themselves near and around these organs that surgery which is both radical and safe is impossible. Radium by destroying the embryonic cells before it injures normal mature cells takes precedence over surgery in these advanced cases of cancer of the cervix. Percy claims the same advantages for slow heat. In the more chronic forms of cancer so located that the growth and nearby lymphatics can be removed with ease such as cancer of the breast and gastro intestinal tract including the rectum surgery rightfully claims the field. For deep incurable malignancies and their lymphatic metastases for growths of the sarcomatous or lymphosarcomatous types and as a postoperative prophylactic treatment radiotherapy claims the field and acts through

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pain, tenderness swelling and local heat. Tuberculous joints must not be interfered with for fear of a flare up. From a purely technical viewpoint means must be taken to prevent union of the newly made surfaces and in all except the jaw, interposition of a piece of tissue preferably autogenous is necessary.

The technique varies with the type of joint to be reconstructed. In operating on the jaw owing to the structures of its joint mere excision gives excellent results. Excision is also satisfactory in the upper extremities but is less compatible with good function in the lower extremities where the problem of weight bearing is concerned. This is the most probable explanation of the contention that excisions are comparable in their results to arthroplasty. The surfaces must be reconstructed by the removal of just enough bone to allow a range of motion that will be sufficient for the function of the joint and still maintain the maximal stability. Suitable postoperative splintage must be provided for both the upper and lower extremities, but for the latter sufficient traction must be insti-

tuted to separate the new joint surfaces. Mobilization must be started as soon as the blood clot is organized. Active and passive motion must be gradually forced to the limit, and at the same time physiotherapy, consisting of light, heat, massage, and exercise must be consistently carried out.

All surgeons emphasize the great necessity of the careful selection of patients who are to be subjected to arthroplasty. It must be considered first whether a movable joint will be more useful to the patient than the stiff one he already has, taking into account his occupation and his economic state and second, the stability of the patient's nervous system and ability to stand pain must be determined. The patient's cooperation is necessary in order to carry out the after treatment, which takes considerable time and often results in soreness and pain. Nervous excitable unstable patients, especially if they are intolerant of pain, are not good subjects for the operation. It is very evident that children should not be subjected to the operation.

MELVIN S. HENDERSON

tiate the true and the spurious by remembering certain principles of ethics in science. He who reveals the cause and nature of cancer must be a true scientist. The scientist is a devotee of truth. He courts investigation and therefore submits his facts to his peers before submitting them to the public. When he publishes them he gives them to the scientific press before giving them to the lay press. In revealing great fundamental truths in medicine there has been no notable exception to this rule.

The scientific physician is an altruist. His mission is to save life, prevent disease, restore health. He never withholds from other members of his profession any remedy or agency that may be of value in the treatment or prevention of disease. He never arrogates to himself an exclusive or secret remedy for purposes of personal gain. The scientific physician would rather be a Pasteur in poverty than an Abrams in affluence.

R. C. COFFEY

## ARTHROPLASTY

THE mobilization of ankylosed joints is one of the problems that confronts modern surgery. Here and there at odd times the subject has been brought forward for discussion. The rarity of ankylosis as compared with other lesions that the surgeon is called on to relieve, the somewhat exacting technique and the extremely important position that the long postoperative supervision assumes in the management of these cases have all been factors in the inexperience with arthroplasty of many otherwise experienced surgeons. The advancement of the specialties to their present position of increased surgical responsibility has caused just this type of case to gravitate naturally into the hands of the orthopedic surgeon and the reports now forth-

coming as a result of this segregation make possible a true perspective and place the proper value on arthroplasty. Large series of cases are reported wherein as high as 80 per cent of the results of arthroplasty are satisfactory. A symposium at the International Surgical Association in London in 1923 crystallized to a certain extent our knowledge of the subject. The discussion brought out clearly that arthroplasty was considered by some of the members to include all operations which had as their object the establishment of motion in an ankylosed joint. Accordingly, excisions were mentioned on equal terms with arthroplasty. The Italian and American participants in the symposium, however, contended that arthroplasty was considerably more than an excision. Arthroplasty has gradually developed and become standardized, the technique being modified according to the anatomic structure and the physiologic function of the joints. Prominent in such development have been the late J. B. Murphy, Putti Baer, Campbell, MacAuland and others. In America arthroplasty is considered to be a refined excision, its object being not only to produce motion but to furnish stability and the operation is definitely planned and executed with these two objects in view.

The arthroplastic operations performed in the Mayo Clinic were reviewed recently and 103 of 142 patients were traced. The results of the operation were satisfactory in 81 per cent of cases, either excellent or good in 62 per cent and excellent in 38 per cent. The operations on the jaw gave the best results, the elbow the next best, the knee next and the hip the poorest. From the findings in this and other series certain fundamental principles can be deduced.

The destructive arthritis following the infection or trauma of a joint must be thoroughly quiescent and manifested by absence of



JOHN COLLINS WARREN  
1778-1856



# MASTER SURGEONS OF AMERICA

## JOHN COLLINS WARREN

JOHN COLLINS WARREN was born in Boston on August 1, 1778. His grandfather, Joseph, was a prosperous farmer settled in Roxbury. His father, Dr. John Warren, was the younger brother of Dr. Joseph Warren, the Revolutionary patriot who was killed at Bunker Hill. John Warren was one of the founders of the Harvard Medical School. Warren's mother, Abigail, was the daughter of John Collins, Governor of Rhode Island from 1786 to 1789.

Warren received a good education in the Boston Latin School, graduating with honors and being the first to receive the Franklin Medal. Entering Harvard College in 1793, he graduated in 1797 with a class of 54, having a part in the commencement exercises.

He was not strong in body and not much given to worldly pleasures but strong in will power and in resolution to make the most of his opportunities. His serious bent of mind seems to have been partly inherited and partly molded from his environment. His grandmother, a pious lady held in great esteem in her community, was still living. She had brought up a family, two of whom had been conspicuous examples of patriotism, his father John having also served in the Revolutionary Army as surgeon. Some of these qualities may also have been derived from Governor Collins, particularly those which enabled him in after life to rule with a stern hand.

At the time of his graduation, he had formed no decision as to the future, nor does he appear to have been biased by any parental influence. He was the eldest child of a family of seventeen and the economic situation was probably a trying one. A mercantile career seemed the obvious solution of the difficulty but the call of medicine must have been in the blood for, at the close of a year's time, he entered the Harvard Medical School. After a year of study in this institution, which was still in its infancy, he decided to complete his medical education in Europe. Accordingly he embarked for London in June, 1799, and on his arrival made an arrangement with Mr. William Cooper, surgeon at Guy's Hospital, to be his dresser for a year for which he paid a fee of 50 guineas. As Mr. Cooper was the senior surgeon and made comparatively few hospital visits during the week, Warren had from the beginning almost complete control of his patients. Mr. Cooper was near the close of his professional life and before Warren left London

was succeeded by his nephew, Astley Cooper, and there was then formed between the pupil and his distinguished teacher a friendship that lasted throughout life. In London were great opportunities for study at the clinics of Cline in surgery, of Haighton in midwifery, of Abernethy at St. Bartholomew's and at St. George's, under Sir Everard Home he was enabled to get almost at first hand the teaching of the new science of surgical pathology, so recently inaugurated by Hunter.

A European medical education would have hardly been complete at this period without a visit to the Royal Infirmary in Edinburgh where he passed the following academic year. The faculty of this school contained names still remembered as leaders in medical thought at that time, such as Munro in anatomy, John and Charles Bell in surgery, Hope in chemistry and Gregory in medicine. Warren also became a member of the Royal Physical Society of Edinburgh, which brought the students and teachers into close contact for discussion and study.

In June, 1801, Warren left Edinburgh for Paris and passed the following winter in the household of Dubois, one of Napoleon's distinguished surgeons. This enabled him to meet many of the prominent teachers of that day. His clinical studies were conducted chiefly at La Charité. His chief pursuits were chemistry under Vauquelin and anatomy under Ribes, Chaussier, Roux and Dupuytren. Bichat was one of the great lights of this period which was a brilliant one in medicine. These with daily visits to the hospital occupied him somewhat more than 12 months. He notes that the French students with whom he was thrown were green from the Revolution and were for the most part a rude and vulgar set. Many hours were spent at the Jardin des Plantes, where he acquired a taste for natural history that became conspicuous in later years.

At the end of the following summer he went to London and sailed for New York arriving there in the autumn of 1802. He brought home with him the degree of M.D. from St. Andrews. On his return he was immediately plunged into a large practice owing in part to the ill health of his father who had been for many years the leading practitioner of Boston. Warren records the fact that in the following summer, when he had entire charge of his father's work, he made some 50 visits a day. During the next winter he acted as prosector to his father for anatomical lectures at Cambridge.

In 1803 he married Susan Powell Mason, daughter of Hon. Jonathan Mason, a prominent merchant of Boston, and in 1805 he occupied a house on Park Street in which he resided for the remainder of his life. It was a roomy mansion, situated in the center of the residential quarter of a town which preserved strongly the earmarks of its English origin. The medical school was still in Cambridge and the apprentice system seems to have not yet been wholly abandoned. The Park Street house provided space not only for a class of medical students to foregather in a room with its sanded floor but for a certain period found room to accommodate a dispensary service.



that "the operations of lithotomy in Boston within the last sixty years have been performed by my father, myself or my son" (Mason Warren) His position as editor fitted him well to record in writing a vast amount of surgical experience covering this long period His most important publication was a book in 1837, "Surgical Observations on Tumors" which received a great deal of attention in this country and in Europe and was translated into the German language It is evident also that he had the intention of writing a book on "Clinical Surgery" The manuscript for this work which had accumulated in great quantity but was never published covers a most interesting period of surgical practice during the early part of the century A few examples will suffice to illustrate this point An operation for the removal of a loose cartilage from the knee joint is given in detail the patient, after slight suppuration and some fever, attaining full convalescence and a satisfactory result Several cases of dislocation of the hip joint are given and we find here, not only the old time method of reduction by pulleys but a detailed statement of the method of reduction by taxis, such as was described by Bigelow and others a quarter of a century later The reduction of a dislocation of a shoulder joint is effected by a method corresponding accurately to that now known as Kocher's Method

After some 30 years of active work Dr Warren turned his practice over to his son and made a trip through Europe with his family He renewed his acquaintance with Sir Astley Cooper and revisited the scenes of his study in Edinburgh, seeing there Sir Charles Bell In Paris, he met Lous for the first time and obtained from Civiale the details of his new operation for lithotripsy—which he was instrumental in introducing into this country on his return

Mrs Warren died in 1841 and two years later he married Anne Winthrop, after her death in 1851 he made another European visit, receiving great hospitality from political as well as professional friends It was during this journey that he met Brodie and Clarke in London, and Velpeau in Paris Although this trip was undertaken in search of health the benefit proved only temporary and he was unable on his return to go back to full active professional life but did devote much time and labor to scientific and literary work and was fully occupied in these pursuits almost to the date of his death

Dr Warren was elected a corresponding member of the Royal Academy in Paris as well as of the Medical Society of Florence an honorary member of the Medical and Chirurgical Society of London, and he also belonged to the American Philosophical Society of Philadelphia and to numerous other medical and scientific organizations both in this country and abroad

In 1846 the medical school which by this time had outgrown its building was removed to a new site nearer the hospital Dr Warren took this opportunity to present his collection of anatomical specimens to the University, accompanied by a suitable endowment and it has since been known as the Warren Museum of

In 1806 Warren was appointed adjunct professor of anatomy and surgery in Harvard University. He became prominent in the work of the Massachusetts Medical Society and, in collaboration with his life long friend and colleague Dr James Jackson he edited the *Pharmacopæia* published by this society in 1808. Previous to 1811, no M D degree had been issued by Harvard but in 1819 Dr Warren received the distinction of an honorary M D degree from this University.

Dr James Jackson had been appointed professor of the theory and practice of medicine in the place of Dr Benjamin Waterhouse, and Warren at the time of the death of his father in 1815 became professor of anatomy and surgery. These two men set about to lay out a more comprehensive plan for medical education. Their appeal in a circular letter to the public in 1810 became a document of especial interest for in it there was called attention not only to the great benefits of a hospital to suffering humanity but to the important part which it played in the scheme for medical education. Their statement "A hospital is an institution absolutely essential to a medical school, probably marks the first formal effort to elaborate an organization so characteristic of modern methods. A new medical school building was completed in 1815 and the Massachusetts General Hospital was opened for patients in 1821. The tie that bound these institutions was not as close as would be thought necessary at the present time but it served its purpose fairly well at that early period. At the opening of this hospital Dr Warren was appointed visiting surgeon and Dr Jackson visiting physician. These two constituted practically the hospital staff for many years.

On the death of Caspar Wistar in 1818 the professorship of anatomy in the University of Pennsylvania was offered to Dr Warren and it may be interesting to mention in this connection that later on his return from Europe in 1838, he was offered the position of professor of anatomy and dean of the faculty in the University of New York. To both of these invitations he returned a decisive answer in the negative.

In 1812 the *New England Journal of Medicine and Surgery* was issued under the auspices of the medical school and this periodical was subsequently merged (1828) with the *Medical Intelligencer* to form the *Boston Medical and Surgical Journal* a weekly publication in operation ever since. Dr Warren became its first editor and numerous articles on medical subjects flowed from his pen. A treatise on Diseases of the Heart and one on Comparative Anatomy of the Nervous System were among his early writings.

Dr Warren brought back from Europe many novel ideas in the way of operative surgery among which may be mentioned the operations for aneurism and strangulated hernia the latter of which he states met with considerable opposition at first. He was one of the first to perform operations on the fissures of the hard and soft palates after the manner of Roux. His surgical practice became a commanding one, as had been that of his father before him. He notes later (1852)

that "the operations of lithotomy in Boston within the last sixty years have been performed by my father, myself or my son" (Mason Warren) His position as editor fitted him well to record in writing a vast amount of surgical experience covering this long period His most important publication was a book in 1837, "Surgical Observations on Tumors" which received a great deal of attention in this country and in Europe, and was translated into the German language It is evident also that he had the intention of writing a book on 'Clinical Surgery' The manuscript for this work which had accumulated in great quantity but was never published, covers a most interesting period of surgical practice during the early part of the century A few examples will suffice to illustrate this point An operation for the removal of a loose cartilage from the knee joint is given in detail the patient after slight suppuration and some fever, attaining full convalescence and a satisfactory result Several cases of dislocation of the hip joint are given and we find here not only the old time method of reduction by pulleys but a detailed statement of the method of reduction by taxis, such as was described by Bigelow and others a quarter of a century later The reduction of a dislocation of a shoulder joint is effected by a method corresponding accurately to that now known as Kocher's Method

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Mrs Warren died in 1841 and two years later he married Anne Winthrop after her death in 1851 he made another European visit receiving great hospitality from political as well as professional friends It was during this journey that he met Brodie and Clarke in London, and Velpeau in Paris Although this trip was undertaken in search of health the benefit proved only temporary and he was unable on his return to go back to full active professional life but did devote much time and labor to scientific and literary work and was fully occupied in these pursuits almost to the date of his death

Dr Warren was elected a corresponding member of the Royal Academy in Paris as well as of the Medical Society of Florence an honorary member of the Medical and Chirurgical Society of London and he also belonged to the American Philosophical Society of Philadelphia and to numerous other medical and scientific organizations both in this country and abroad

In 1846 the medical school which by this time had outgrown its building was removed to a new site nearer the hospital Dr Warren took this opportunity to present his collection of anatomical specimens to the University, accompanied by a suitable endowment and it has since been known as the Warren Museum of

In 1806 Warreo was appointed adjunct professor of anatomy and surgery in Harvard University. He became prominent in the work of the Massachusetts Medical Society and, in collaboration with his life long friend and colleague Dr James Jackson, he edited the *Pharmacopæia*, published by this society in 1808. Previous to 1811 no M D degree had been issued by Harvard but in 1819 Dr Warren received the distinction of an honorary M D degree from this University.

Dr James Jackson had been appointed professor of the theory and practice of medicine in the place of Dr Benjamin Waterhouse, and Warren, at the time of the death of his father in 1815 became professor of anatomy and surgery. These two men set about to lay out a more comprehensive plan for medical education. Their appeal in a circular letter to the public in 1810 became a document of especial interest for in it there was called attention, not only to the great benefits of a hospital to suffering humanity but to the important part which it played in the scheme for medical education. Their statement "A hospital is an institution absolutely essential to a medical school" probably marks the first formal effort to elaborate an organization so characteristic of modern methods. A new medical school building was completed in 1815 and the Massachusetts General Hospital was opened for patients in 1821. The tie that bound these institutions was not as close as would be thought necessary at the present time but it served its purpose fairly well at that early period. At the opening of this hospital Dr Warren was appointed visiting surgeon and Dr Jackson visiting physician. These two constituted practically the hospital staff for many years.

On the death of Caspar Wistar in 1818 the professorship of anatomy in the University of Pennsylvania was offered to Dr Warren and it may be interesting to mention in this connection that later, on his return from Europe in 1838 he was offered the position of professor of anatomy and dean of the faculty in the University of New York. To both of these invitations he returned a decisive answer in the negative.

In 1812, the *New England Journal of Medicine and Surgery* was issued under the auspices of the medical school and this periodical was subsequently merged (1828) with the *Medical Intelligencer* to form the *Boston Medical and Surgical Journal* a weekly publication in operation ever since. Dr Warren became its first editor and numerous articles on medical subjects flowed from his pen. A treatise on Diseases of the Heart and one on Comparative Anatomy of the Nervous System were among his early writings.

Dr Warren brought back from Europe many novel ideas in the way of operative surgery among which may be mentioned the operations for aneurism and strangulated hernia the latter of which he states met with considerable opposition at first. He was one of the first to perform operations on the fissures of the hard and soft palates after the manner of Roux. His surgical practice became a commanding one, as had been that of his father before him. He notes later (1852)

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**Anatomy** He also left directions that, on his death his body should be dissected and his skeleton prepared, articulated and hung in the Museum where it remains to this day. He had passed through the trying times which ultimately terminated in the passage of the Anatomy Act. Those who may feel inclined to criticize such a disposition of his body, have only to refer once more to the repulsive details of the trial of Burke and Hare and the fate of some of those professors whom they served, to look upon Dr Warren's judgment from a new point of view.

In 1849 the American Medical Association held its annual meeting in Boston and Dr Warren was elected president and delivered the annual address at the gathering in Cincinnati the following year. A pen picture of Dr Warren by a contemporary gives an interesting description of the personality of the man. "His appearance was remarkable and such as to attract the attention of everyone who came in contact with him. His almost painfully thin yet upright form, his high forehead covered with scanty gray hair, his shaggy eyebrows shading his bright piercing eyes, the deep lines in his strongly marked face—all showed the man of iron will and cool fearless determination. Nor was this in any way disproved by the high brusque, authoritative tones of his voice when lecturing or about to engage in some operation. Here the wonderful steadiness of his hand, the unyielding unimpassionable character of his nervous system, when interested in any detail of his profession, showed one reason for his professional success."

Dr Warren was a man of deep religious turn of thought and a devoted member of St. Paul's Episcopal Church. For 30 years he was president of the Massachusetts Temperance Society and contributed largely of his means toward its success. Of his experience in this work he says: "On the whole I can with confidence say that if I had never tasted wine my life would have been more healthy and longer and more comfortable. The efforts which I have been called to make in the temperance reformation operating as they have done more extensively on the prosperity and happiness of the community are a source of more satisfaction than any other labors. Probably my other occupations might have been as well or better performed by someone else, but perhaps it would have been difficult to find another person who would have been willing to undergo the opposition, ridicule, labor and expense in the cause of temperance."

Dr Warren's collection in the domain of comparative anatomy and of fossils remains gradually accumulated and, in 1846 when the bones of a mastodon were discovered in the State of New York, he purchased it and had a fireproof building constructed in which to house the entire collection. He published an elaborate work on the bones of this mastodon. The skeleton at the present time is in the collection of the American Museum of Natural History in New York and is known as the Warren mastodon. At the time of his death he was president of the Boston Society of Natural History.

But the crowning event of Dr Warren's career was the part that he played in the introduction of surgical anesthesia. On October 16, 1846, he performed a major operation at the Massachusetts General Hospital while the patient was under the influence of ether administered by Dr William T G Morton. The experiment was so successful that it was used in other operations on the following days. This experience showed that ether as an anæsthetic agent was "safe, certain and complete" —a triple feat which announced to the world that what had been dreamed of for many years had become a reality. In the obituary address at the time of the death of Dr Warren on May 4, 1856, Dr Oliver Wendell Holmes made the following reference to this historic episode: "He had reached the age when men have long ceased to be called on for military duty when those who have labored during their days of strength are expected to repose and when the mind is thought to have lost its aptitude for innovating knowledge, and to live on its accumulated stores yet nothing could surpass the eagerness with which he watched and assisted in the development of the newly discovered powers of etherization. It is much for any name to be associated with the triumphs of that beneficent discovery but when we remember the reproach cast upon Harvey's contemporaries that none of them past middle age would accept his new doctrine of the circulation we confess it to have been a noble sight when an old man was found among the foremost to proclaim the great fact—strangely unwelcome as well as improbable to some who should have been foremost to accept it—that pain was no longer the master but the servant of the body."

J COLLINS WARREN

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<sup>1</sup> *tabl British Trials, Burke and Hare Edinburgh William R. Ghead p 1*

edematous and in places hemorrhagic. When the peritoneal cavity was opened a small amount of bloody fluid escaped and the great omentum was markedly infiltrated and adherent to a mass. When the omentum was pulled away this mass was found which appeared to be an ovarian cyst. Upon looking further it was evident that the mass originated from the left ovary and found its way to the right side. The pedicle was twisted three times and the fallopian tube on the left side took part in the rotation as did also the uterus so that the latter organ was pretty well thinned out and elongated. The tumor was removed and found to be a cystic mass filled with a large quantity of bloody fluid and sebaceous material. In one part there was a rather solid mass which contained a great deal of hair and two teeth. Upon microscopic section considerable cartilaginous tissue, bone, smooth muscle fibers and bronchiogenic tissue was found. It was considered a teratoid dermoid. The specimen is presented because it rarely occurs before the onset of menstruation and also because it was a combination of teratoma and dermoid and was pedunculated and twisted upon its pedicle three times.

#### AN EXPERIMENTAL STUDY OF RUPTURE OF THE UTERUS

DR JULIUS E. LACANER discussed his experimental work on rupture of the uterus. (See p. 69)

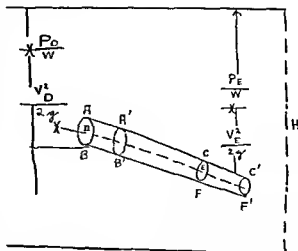
#### DISCUSSION

DR SIMPLY SCROCHET. I am most interested for the present in the hydraulics of this experimental work and shall attempt to explain only the principles of the determination and corrections of the pressure curves. An understanding of Bernoulli's theorem is required and I shall try to explain it in as simple way as possible.

The theorem of Bernoulli. In a steady moving stream of an incompressible fluid in which the particles of fluid are moving in stream lines and there is no loss by friction or other causes the pressure is constant for all sections of the stream and is represented by the formula explained in

$$\frac{P}{w} + \frac{v^2}{2g} + z$$

Let DE (Fig. 1) be the path of a particle of the fluid. Imagine a small tube to be surrounding DE and let the flow in this be steady, and let the sectional area of the tube be so small that the velocity through any section normal to DE is uniform. Then the amount of fluid that flows in at D through the area AB equals the amount that flows out at E through the area CF. Let P and v be the pressure and velocities at D and E respectively and A and a the corresponding areas of the tube. Let Z be the height of D above some datum and Z' the height of E. Then if a very small quantity of fluid



AB and B' equal to centers at D and a similar quantity CFC' leaves at E in a time t the velocity at D is

$$v_D = \frac{q}{At}$$

and the velocity at E is

$$v_E = \frac{q}{At}$$

Since the flow in the tube is steady the kinetic energy of the portion ABCF does not alter and therefore the increase of the kinetic energy of the quantity q

$$= \frac{Wq}{2g} (v_E^2 - v_D^2)$$

The work done by gravity is the same as ABA'B' and therefore

$$= Wq - (Z - Z')$$

and the work done by the pressure at E in time t

$$= P_E avt = -P_E q$$

but the kinetic energy must equal the work done and therefore

$$\frac{Wq}{2g} (v_E^2 - v_D^2) = Wq(Z - Z') + P_D q - P_E q$$

from which

$$\frac{v_E^2}{2g} + \frac{P_E}{w} + Z = \frac{v_D^2}{2g} + \frac{P_D}{w} + Z \text{ constant}$$

From this theorem it is seen that a vertical ordinate equal to the velocity head plus the pressure head erected the upper extremities of these ordinates will be in the same horizontal plane at a height H equal to

$$\frac{P}{w} + \frac{v^2}{2g} + Z \text{ above the datum level}$$

I trust that I have been able to convey the interpretation of this theorem so you may understand how we arrived at our corrections when we considered the frictions of the tubes etc.

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD JUNE 19 1925 DR CAREY CULBERTSON PRESIDING

### SPECIMENS OF INTRALIGAMENTOUS FIBROIDS

DR J L BAER S A aged 49 was admitted to Michael Reese Hospital May 13 1925 She was married but had never been pregnant Menstruation began at the age of 12 was irregular coming on every 4 or 5 weeks and lasting 1 day but was not painful Artificial menopause occurred in 1909 For one month she had complained of a pain in the right lower quadrant of the abdomen accompanied by nausea and vomiting This pain was aching in character and not severe

On physical examination a hard symmetrical tumor was palpable above the pubes and toward the right side This tumor was about the size of a 3 months pregnancy Vaginal examination showed the cervix closed conical and hard the corpus retroflexed and 50 per cent enlarged Anterior to the uterus and to the right was a mass filling the right lateral fornix and extending abnormally from the midline at the level of the umbilicus into the right iliac fossa The mass was soft movable insensitive

Operation performed May 15 1925 revealed a large soft mass the size of a fetal head lying between the layers of the right broad ligament The uterus was the size of a fist and contained a submucous fibroid The layers of the broad ligament were dissected off the mass isolated and removed with the uterus which was amputated subtotally at cervix

The patient left the hospital in excellent condition on June 3 18 days after the operation

The second patient Miss A A aged 23 was admitted to Michael Reese Hospital June 8 1925 She complained of abdominal pain dysmenorrhea and increase in the size of the abdomen The symptoms had been present for 1 year Menstruation began at 13 was regular 2 to 3 days in duration until 1 year ago when the flow became more profuse lasting 6 to 7 days with pain in the back She had had abdominal pain dull aching in character localised in the right lower quadrant for the past year

Physical examination was practically negative except for the abdominal and rectal findings A large firm mass filling the entire abdomen was palpable It was about the size of a full term pregnancy On rectal examination the uterus was found to be acutely retroverted the pelvic inlet occupied by a mass extending upward, filling the abdomen in regular in shape firm in consistency The left and right round ligaments extended along its margins At operation June 11 a very large fibroid was

found lying within the folds of both broad ligaments and removed The uterus was normal and left *in situ* The left ovary contained a small cyst which was also removed

The patient was in the hospital at the time the case was reported but was doing nicely

The small specimen is an intraligamentary fibroid which in the formalin has shrunk to about half its size The other is a submucous intra uterine fibroid The intraligamentary fibroid is practically continuous with the submucous intra uterine fibroid as if there were a perforation The abdomen was about the size of a full term pregnancy The tumor was very soft I attempted to incise the abdomen below the umbilicus I extended the incision some what and was able to evert the whole tumor The fibroid on the back of the uterus was over the promontory I was able to strip off the bladder entirely and the round ligaments tubes and ovaries and other attachments posteriorly with the fundus of the uterus and then examine the true pelvis This intraligamentary fibroid was in the pelvis in the circular space back of the bladder and in front of the cervix close down to the rectum I took it out with out detaching it and obliterated the space by a few sutures All the genitalia were conserved This case is interesting because the tumor spread into both broad ligaments

### TERATOID DERMOID

DR E W FISCHMANN The patient age 17 years came into the County Hospital on the fourth day of her illness She was taken ill suddenly with nausea and vomiting which continued up to the time of admission to the hospital She also had severe pain in the abdomen which started in the right side and persisted in that region Her temperature was 104 degrees pulse 140 and leucocyte count 26 600 The urine was negative and the blood picture was normal except for the leucocytosis Upon abdominal examination the abdomen was found to be distended and rigid particularly on the right side where there was some bulging Upon rectal examination a mass could be made out in the right lower quadrant which was immobile The preoperative diagnosis was acute appendicitis with abscess formation

The abdomen was opened through a McBurney incision The peritoneum was found to be markedly

to tackle this problem. If in every hospital in the city the work in each department were in charge of one man it would be united to the great advantage of both hospitals and patients. If there are two or more co-ordinate members of the staff in each department each will have his own way of doing things. A great many outsiders are also admitted to the hospitals. In one hospital where I work two thirds of the obstetrics is done by outsiders. At the Cook County Hospital the work is better correlated. Would it be possible to adopt some rules in regard to consultation in important cases? If a caesarean section is proposed on a case let it be done only after consultation with one or more members of the staff. Perhaps the same rule might be adopted in cases of high forceps and version.

Dr DAVID S HILL. Dr Bacon's suggestion as to a possible method of unification of procedure at the County Hospital is interesting. Personally I have not had the temerity even to suggest such a thing. I would be very pleased as a member of the staff to co-operate in a plan of that kind. I suppose that all hospitals perhaps would improve their obstetrics if no operation were undertaken without consultation. There are more sins of commission than of omission in obstetrics. If every man who operated on confinement cases had to state his reason for so doing I think we would reduce our operations about one half. If there is to be any improvement in obstetrics it must start somewhere and in this community it seems to me the Gynecological Society is the place where it should start. Obstetrics is not given more serious consideration because no one but the obstetrician is interested. The leaders in surgery, medicine and other specialties are indifferent to the problems of better obstetrics. The Shepard-Towner law implies an indictment of the medical profession of unmistakable meaning. The doctors are spending money to advertise the medical profession yet no effort is made to correct the conditions that led to the Shepard-Towner law. Is it not possible that some organized effort in this direction would be of use in the campaign to make the medical profession more popular?

Dr J B DeLee. In the first place I wish to express my usual incredulity about vital statistics. Statistics to be of any value at all have to be very carefully dissected. For example the Cook County Hospital cares for a certain class of patients. Another hospital cares for a different class entirely. Labor will be more likely to run a spontaneous course in one than in the other. Cook County Hospital receives patients who present immunities from infection developed from birth and who are injured to hard labor. Other hospitals receive patients who are the refined products of modern civilization and whose resistance is poorly developed. Therefore it is a waste of time to devote any discussion to comparative statistics.

Dr Bacon's suggestion is a good one. The Cook County Hospital is the only hospital I know where it is possible to have any co-operation in the staff.

There are only four obstetricians and it is a closed hospital. The four could get together and decide on the practice of obstetrics. There is no other hospital that has such a closed system. At the Lying in Hospital there were 111 different doctors beside the members of the staff who treated cases there last year and it is impossible to carry out any technique except the aseptic technique. We do insist on that. Even then men will deliberately or surreptitiously work in other methods.

The frequency of operations depends very largely on the man. Dr Hullis says that 50 per cent of the obstetrical operations would be unnecessary if the men had to write the conditions on the wall for everybody to read. I think this is even more true in surgery. You go into some hospitals and you will see cholecystectomies or cholecystostomies or gastro-enterostomies posted every day in large numbers. If every man who performs a gastro-enterostomy had to give his reasons publicly for doing an operation it would reduce the number of operations. The obstetrician is no worse than the surgeon in that regard. What is the cause of it? It is simply that practitioners do not know enough obstetrics. They have to be taught more in the line Dr Lee mentioned—fundamental obstetrics and less of the high spots. The principles have to be correlated with technical obstetrics. The work is very hard. To improve the teaching of obstetrics has been the goal of the Chicago Lying in Hospital for years and I believe today the obstetrical practice there is just as good as the surgical practice. The examples of terrible mistakes referred to by Dr Lee I can match by relating corresponding and even greater horrors that have occurred in the practice of men in our own midst and at the hands of men who have been practicing obstetrics for years and who enjoy the title of professor. We have to improve our teaching and we should spend the time teaching normal obstetrics as well as pathological and we will have to pay the teachers to do the grueling work.

Dr W GEORGE LEE (closing the discussion). I merely want to thank those who discussed the paper and also the members of the society for their patience. I may say that we of the Cook County Hospital think that the staff obstetrical work is very good and that we have closer co-operation there than is usually found. We do not hesitate to advise about cases as a matter of fact and we review cases of poor outcome with very free discussion. I think an underlying need is as Dr DeLee said that we should have more time and attention given to teaching fundamentals in the medical schools. I have been very much interested in finding that the students from Rush who come under my charge later come over even when they are not enrolled in my section for they say the clinical work is what they need.

ROENTGENOGRAPHIC DIAGNOSIS IN GYNECOLOGY, PNEUMOPERITONEUM

Dr IRVING F STEIN read a paper on roentgenographic diagnosis in gynecology. (See p 83.)

From the comparative study of the graphs it appears that the type of suture plays an important rôle and that the strength of union of the incised uteri depend on the rate of growth of the connective tissue. We need not consider the smooth muscle (uterine) as it is doubtful whether smooth muscle regenerates.

Dr MARK GOLDSTONE: Rupture of the uterus may be obtained by increasing intra uterine pressure without a cesarean section. It does not make much difference what kind of suture material is used if endometrial tissue or infection is present in the scar, rupture is apt to occur.

Dr J L BAER: If we knew the length of time between the operation and the subsequent rupture in other words what time interval was allowed for the scar to heal it might have a bearing on our estimate of the integrity of the scar.

Dr DAVID S HILLIS: The question of rupture of the uterus through a cesarean section scar is a very important problem at this time. The need for a correct solution is more urgent as the field for abdominal delivery becomes broader. Whenever we have a patient who has had a cesarean section and is pregnant again we always ask ourselves if this is to be another cesarean. We can never answer that question safely and properly before the patient tries labor. I do not suppose that the author believes that he has settled this question. If his work has contributed ever so little to our knowledge of this problem it has been worth while. I have opened many uteri that have had previous cesareans, some of the ones I am sure would have held in a reasonably easy labor in other the scar would undoubtedly have ruptured under the strain. I do not know what is the best kind of a stitch to use in repairing the section wound whether interrupted or continuous it would seem that an absorbable suture material would be best but this question is not settled. Infection would be expected to have an unfavorable effect but I have seen very firm scars after a febrile puerperium.

Dr J L BAER: As Dr Hillis said when a patient who has had one cesarean operation becomes pregnant the second time it is a question as to what should be done. The case in point is one I had the privilege of presenting before the society some years ago. I did a cesarean section and immediately afterward the woman had a massive collapse of the lung.

The case was significant because the patient had a fibroid which was very big and blocked the passage. With involution the fibroid had shrunken down to the size of a fist. It was on the back wall and immediately after delivery the fibroid started at the promontory and the corpus was up to the umbilicus. I removed the fibroid by myomectomy. This uterus had a vertical incision anteriorly through the uterine wall and a vertical incision posteriorly that was two thirds through the uterine wall. The patient became pregnant recently and it had to be decided whether a section should be performed or if she should be allowed to go into spontaneous labor. I

let her come into the hospital and go into labor spontaneously. After 6 hours this practically primipara had brought the head down to the midplane. I did a manual rotation with simple extraction and fortunately the outcome was a happy one.

Dr J I GREENHILL: May I ask Dr Lackner whether he took into consideration the difference in the mechanics between contraction and overdistention of the uterus. I believe that all the uteri in Dr Lackner's experiments were ruptured by increasing the intra uterine pressure. As I understand it a uterus usually ruptures at the height of a contraction. We have a good example of this when after pituitrin is administered the rupture occurs at the height of a violent contraction or series of contractions. I wonder whether tracings were made to see if any of the uteri ruptured at the height of a contraction.

I was glad to hear Dr Hillis mention the lower uterine segment because there are perhaps only two authentic reports of a rupture of the lower uterine segment following a cervical cesarean section in which the entire incision was limited to the lower uterine segment. Did the authors have an opportunity to study scars in the lower uterine segment and to compare them with the scars in the fundus?

Dr LACKNER (closing the discussion): I wish to say that this is only a preliminary report. There has been no previous work done in determining the amount of pressure needed to rupture the uterus. A great deal of our time has been given to the determination of the normal pressure required to rupture the uterus. The other factors have not been worked out at present.

Seven to 10 months have elapsed between the operation and rupture of the uterus. In reviewing the literature we found no report of a rupture of the lower uterine segment that was a true rupture. In each case in which reports of rupture were shown the rupture apparently was through the incision which was supposed to be a true low cervical cesarean section incision. However the incisions extended into the body of the uterus.

We have not been able to do cesarean sections in the lower uterine segment on the goats, nor do we wish to draw conclusions at the present in reference to the necessity of a second cesarean section. Only the tensile strength of uterine muscle is considered.

## THE TEACHING AND PRACTICE OF OBSTETRICS

Dr W GEORGE LEE read a paper on the teaching and practice of obstetrics. (See p. 4.)

## DISCUSSION

Dr C S BACON: Detailed analysis of the reports in the Cook County Hospital show that there is a great deal of difference in the practice of the different members of the obstetrical department. That is a fact of great importance. In our efforts to improve hospital practice it seems to me that it is necessary

to tackle this problem. If in every hospital in the city the work in each department were in charge of one man it would be unified to the great advantage of both hospitals and patients. If there are two or more co-ordinate members of the staff in each department each will have his own way of doing things. A great many outsiders are also admitted to the hospitals. In one hospital where I work two thirds of the obstetrics is done by outsiders. At the Cook County Hospital the work is better correlated. Would it be possible to adopt some rules in regard to consultation in important cases? If a caesarean section is proposed on a case let it be done only after consultation with one or more members of the staff. Perhaps the same rule might be adopted in cases of high forceps and version.

Dr DAVID S. HILLIS. Dr Bacon's suggestion as to a possible method of unification of procedure at the County Hospital is interesting. Personally I have not had the temerity even to suggest such a thing. I would be very pleased as a member of the staff to co-operate in a plan of that kind. I suppose that all hospitals perhaps would improve their obstetrics if no operation were undertaken without consultation. There are more sins of commission than of omission in obstetrics. If every man who operated on confinement cases had to state his reason for so doing I think we would reduce our operations about one half. If there is to be any improvement in obstetrics it must start somewhere and in this community it seems to me the Gynecological Society is the place where it should start. Obstetrics is not given more serious consideration because no one but the obstetrician is interested. The leaders in surgery, medicine and other specialties are indifferent to the problems of better obstetrics. The Shepard-Towner law implies an indictment of the medical profession of unmistakable meaning. The doctors are spending money to advertise the medical profession yet no effort is made to correct the conditions that led to the Shepard-Towner law. Is it not possible that some organized effort in this direction would be of use in the campaign to make the medical profession more popular?

Dr J. B. DeLEE. In the first place I wish to express my usual incredulity about vital statistics. Statistics to be of any value at all have to be very carefully dissected. For example the Cook County Hospital cares for a certain class of patients. Another hospital cares for a different class entirely. Labor will be more likely to run a spontaneous course in one than in the other. Cook County Hospital receives patients who present immunities from infection developed from birth and who are insured to hard labor. Other hospitals receive patients who are the refined products of modern civilization and whose resistance is poorly developed. Therefore it is a waste of time to devote any discussion to comparative statistics.

Dr Bacon's suggestion is a good one. The Cook County Hospital is the only hospital I know where it is possible to have any co-operation in the staff.

There are only four obstetricians and it is a closed hospital. The four could get together and decide on the practice of obstetrics. There is no other hospital that has such a closed system. At the Living Hospital there were 131 different doctors beside the members of the staff who treated cases there last year and it is impossible to carry out any technique except the a-ptic technique. We do insist on that. Even then men will deliberately or surreptitiously work in other methods.

The frequency of operations depends very largely on the man. Dr Hillis says that 50 per cent of the obstetrical operations would be unnecessary if the men had to write the conditions on the wall for every body to read. I think this is even more true in surgery. You go into some hospitals and you will see cholecystectomies or cholecystostomies or gastro-enterostomies posted every day in large numbers. If every man who performs a gastro-enterostomy had to give his reasons publicly for doing an operation it would reduce the number of operations. The obstetrician is no worse than the surgeon in that regard. What is the cause of it? It is simply that practitioners do not know enough obstetrics. They have to be taught more in the line Dr Lee mentioned—fundamental obstetrics and less of the high spots. The principles have to be correlated with technical obstetrics. The work is very hard. To improve the teaching of obstetrics has been the goal of the Chicago Living Hospital for years and I believe today the obstetrical practice there is just as good as the surgical practice. The examples of terrible mistakes referred to by Dr Lee I can match by relating corresponding and even greater horrors that have occurred in the practice of men in our own midst and at the hands of men who have been practicing obstetrics for years and who enjoy the title of professor. We have to improve our teaching and we should spend the time teaching normal obstetrics as well as pathological and we will have to pay the teachers to do the grueling work.

Dr W. GEORGE LEE (closing the discussion). I merely want to thank those who discussed the paper and also the members of the society for their patience. I may say that we of the Cook County Hospital think that the staff obstetrical work is very good and that we have closer co-operation there than is usually found. We do not hesitate to advise about cases as a matter of fact and we review cases of poor outcome with very free discussion. I think an underling need is as Dr DeLee said that we should have more time and attention given to teaching fundamentals in the medical schools. I have been very much interested in finding that the students from Rush who come under my charge later come over even when they are not enrolled in my section for they say the clinical work is what they need.

#### ROENTGENOGRAPHIC DIAGNOSIS IN GYNECOLOGY PNEUMOPERITONEUM

Dr IRVING F. STEIN read a paper on roentgenographic diagnosis in gynecology. (See p. 83.)



## CORRESPONDENCE

ARTIFICIAL VAGINA THE  
BALDWIN OPERATION

To the Editor Since the method of operation for absence of vagina by transplanting a loop of bowel was described by me more than 10 years ago<sup>1</sup> that operation has been performed on the whole in a relatively large number of cases though no attempt has ever been made to determine even the approximate number

In the original description of the operation the statement was very positively made and has been repeated as opportunity offered subsequently that while the operation was a simple straightforward procedure it was not one for surgical tyro Recently several writers particularly in Germany have claimed quite a large mortality for this operation and have contrasted it with the alleged absence of mortality from the Schubert operation by which the lower four inches of the rectum are mobilized and used for a vagina As my operation as originally devised should have no larger mortality than would result from the resection of a piece of intestine in a healthy patient it seems very evident that the warning as to tyros has been disregarded and with the anticipated ill results

So far as known no modification of the original operation has been suggested which in any respect has proved advantageous If a single piece of bowel is used the resulting vagina is too small if the opening through the tissues is too small or if after the loop of bowel has been brought down and opened the two sides are not reasonably packed with gauze the resulting vagina will again be too small but if the directions originally given are strictly followed such a failure I think will be impossible A few months ago I had the pleasure of seeing with Dr Allen B Kanavel a patient whom he was about to discharge after successfully making his first artificial vagina operation He said that before operating he had made a careful study of all the methods suggested and so called improvements in methods but had finally adopted the method as originally published

One case has been reported to me in which at the end of what had seemed to be a perfect convalescence the transplanted bowel suddenly escaped from its environment and appeared on the dressings In this instance the operator was a fine surgeon but he perhaps failed to see that there was an ample blood supply in the mesentery attached to the portion of bowel selected or possibly he made a too snug closure of the peritoneum around that mesentery and thus cut off the blood supply

An Surg 904, September

In my personal work I have had but one death and that I am confident would not have occurred had it not been that the patient and her husband were foreigners so that it was impossible to explain the necessary after treatment and no enemas or stomach lavage were permitted The case presented no evidence of peritonitis or ileus and the usual postoperative treatment if permitted would almost certainly have given the usual favorable result

The patients upon whom I have operated have all been private patients and I have heard from most of them and to the effect that everything is normal There has been no case of more than normal moisture in the new vagina there has been no dyspareunia reported and no divorces

Professor William T Black<sup>2</sup> of the Memphis Medical College as a result of his investigations of the work of many hospitals and operators has found that the average mortality in hysterectomy for fibroids with removal of the cervix is 10 per cent while without removal of the cervix the mortality for the same operation is 5 per cent As the mortality of such operations at the hands of competent surgeons should not exceed 2 per cent the conclusion necessarily follows that it is such operators as furnished the statistics secured by Professor Black that are responsible for the mortality of the vagina operation as reported by the German surgeons

The Schubert operation has never appealed to me as it seemed to be entirely unsurgical and would almost certainly be attended with unsatisfactory results as relates to the rectum and would be a poor makeshift as to the vagina

J T BALDWIN M D F A C S

Columbus Ohio

ONE THOUSAND OPERATIONS FOR GASTRIC  
DUODENAL AND JEJUNAL ULCERS

THROUGH an error in preparing the manuscript for the article by Dr Pauchet Paris France published in the December 1925 issue page 771 the mortality statistics under the heading Gastric Ulcer are incorrectly stated This paragraph should read

The immediate mortality was as follows gastroenterostomy alone for duodenal ulcer 12 per cent gastrectomy for duodenal ulcer 25 per cent resection for gastric ulcer in proximal third of lesser curvature 9 per cent resection for ulcer in the prepyloric portion or in the middle third of the lesser curvature 14 per cent —THE EDITOR

T State J M 94 April p. 664





Waly filius abbas.



**L**ibert totius medicine necessaria cō

tinens quem sapientissimus Waly filius abbas di  
scipulus ab imber moysi filii scilar edidit regis  
inscripfit unde et regalis dispositionis nomē  
assumpit. Et accepit philosophie di  
scipulo ex arabica lingua in latinā sa  
tis ornata reduci. Necnon a  
domino michael de capella ar  
tium et medicine doctore ses  
cundis in omnis a multis  
et diuersis autoribus  
ab eo collectis illu  
strat. Summaque  
diligentia im  
pressus



1523



# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED J. BROWN MD FACS OMAHA NEBRASKA

THE ROYAL BOOK OF Haly Filius Abbas<sup>1</sup>  
THAT period of the history of medicine and surgery following the fall of the great Grecian and Roman empires when the seat of learning moved from continental Europe to northern Africa and Asia and Alexandria became the home of culture affords almost a definite proof that practical knowledge once gained is seldom lost. At this period in the world's history transportation was very slow, printing was not to be discovered until centuries later and the only form of record was the manuscript while knowledge was communicated either by the reading of the manuscript or by word of mouth through the bards and singers. Considering all these difficulties it seems almost miraculous that the knowledge of medicine and surgery as it then existed should have been preserved. Yet with the fall of these great nations in spite of these handicaps and in spite of differences in language medicine and surgery went on as if no change in the world had occurred. The seat of medicine passed across the Mediterranean into Arabia and Persia. Here the little spark of learning tossed away by the decadent Cræco Roman civilization alighted and was fanned into a flame by learned men. From this arose the so called Arabian school not only in medicine and surgery but also in philosophy and mathematics. Though called the Arabian school or period it was by no means limited to the Arabs for nearly all the Orientals Syriacs Persians Jews and Christians called by Arabian names became interested and each added his quota to the sum of human knowledge. The basis of this was naturally the result of the teachings of the Cræco Roman school and so we find most of their medical and surgical writings founded upon the works of Galen Hippocrates Dioscorides Aëlius Paulus of Ægina Onbasius and others though in some cases they go back further even to the Indian and Egyptian teachers.

The Arabian school reached its height from the eighth to the thirteenth centuries. The majority of its great men were mystics and philosophers and few of them made advances in practical diagnosis or treatment. Human dissection was of course forbidden by the Koran and to aid this philosophical thought is always much easier than practical work. However in the tenth century this country furnished a physician and surgeon whose work was to

serve as a model and an authority for seven centuries.

Ali Ben el Abbas also called Haly Abbas Haly Filius Abbas and Ala el Din el Madschusi was born in Persia and belonged to the Magi. He studied medicine under Abu Mahir Musa. The date of his birth is not known but he died in 934 the 384th year of the Hedschra. The record of his work which remains to us today as the tangible result of his effort is called the *Almalika* or Royal book and was dedicated to the Sultan Adhaded Daula Ben Buweik whom he served as physician in ordinary. It was the greatest book of Arabian medicine up to the appearance of the work of Avicenna. Haly Abbas's work was translated in the eleventh century by Constantinus Africanus under the title of the *Antegnum* which he put forward as his own work. A later translation was made by Stephanus of Antioch in 1127. This appeared in print first in 1492 as a folio published in Venice. The volume the title page of which is reproduced here is the Stephanus translation augmented with notes and explanations by Michael de Capella which was printed in Quarto (Lugduni 1523).

The surgical portion of the work occupies 57 of the 319 pages. It takes in the surgery of the entire body. Though actual practice of surgery was usually left to underlings and the actual practice of obstetrics to midwives one is almost led to believe that this man actually did the operative work himself. His instructions are detailed and clear and it seems as if it must have taken actual practice to give him such concise knowledge. As an example in Chapter 40 when discussing after treatment of lithotomy he says if you fear hæmorrhage it is necessary to apply a compress on the wound wet with vinegar and water or water and oil of roses. You order the patient to be flat on his back and you keep the compresses wet constantly with the water and oil of roses. Then on the third day remove the dressings and apply on the wound the black plaster which you have prepared. Then change the dressing each day for some time because of the strength of the urine and apply a new plaster. In addition it is necessary to tie the thighs together with bandages to assure the dressings remaining in place on the wound. If the wound shows one of the accidents to which wounds are subject such as corrosion corruption and others it is necessary to treat it with remedies with which similar things are treated.

<sup>1</sup>Reviewed through the courtesy of the J. A. Greer Library

## REVIEWS OF NEW BOOKS IN SURGERY

**STARTING** with the premise that orthopedic textbooks leave the medical student with too much to digest Sever in his *Textbook of Orthopedic Surgery* proceeds to give in a straightforward simple exposition a description of the surgery of deformities and disabilities of the apparatus of locomotion. Consequently the book claims to be a modest volume for the student's handy reference. It is just that. While it may be a slight shock to the experienced reader to find scoliosis school seating painful and irritating hocks and compression fractures of the vertebrae assembled in a common chapter such correlation from the student's viewpoint is reasonably happy.

Well chosen illustrations including excellent roentgenograms add to the clearness of the author's ideas. The reviewer recommends this small volume to all students and to those practitioners dealing with orthopedic problems.

KILGORE SPEED

**THE** beautifully illustrated book by Sheehan describes in detail the correction of the various deformities of the nose. The technical procedures are carefully described and the various steps of the different procedures are clearly and adequately illustrated.

The treatment of two types of deformity, dish face and complete or nearly complete loss of the nose, one might wish to have discussed in more detail. In the correction of the former only the implantation of a group of cartilage implants is considered. Blair's article on page 128 of this issue of *SURGERY, GYNECOLOGY AND OBSTETRICS* indicates both the importance of retraction of the upper lip and the variety of methods that may be used in its correction. From the description of operative procedures for the restoration of extensive defects the reader finds it difficult to form an accurate conception of a complete rhinoplasty.

The absence of any illustrations in the book showing the results obtained by the operative procedures described seems to us an unfortunate omission.

SUMNER L. KOCH

**FACIAL** Surgery by Pickenill is a book of 150 pages is a concisely written and well illustrated record of the author's experience in this branch of surgery. Part I of 24 pages is devoted to principles

TEXTBOOK OF ORTHOPEDIC SURGERY. 5th Edition. By J. M. Sever, M.D., N.Y., and Th. Macmillan, Chicago, 1915.

PLASTIC SURGERY. 2nd Edition. By J. E. Thomas, M.D., F.A.C.S., with a foreword by J. H. E. D. M.D., F.A.C.S., N.Y. York, P. U. B. Hoebe, Inc., 1915.

FACIAL SURGERY. By H. P. Pickens, C.B.E., and M. S. W. With a preface by Sir W. A. B. Th. Lane. Part I. C. B. M. S. N. Y. K. William Wood & Co., 1914.

and technique. Part 2 to military surgery and Part 3 to facial surgery in civil practice. The last part includes sections on benign and malignant tumors, syphilis, lupus, burns, harelip and cleft palate, facial paralysis and ankylosis of the jaw. Many of the latter are brief; the section on facial paralysis for example consists of a brief description of the technique of muscle transplantation but they contain many helpful suggestions that will appeal particularly to the surgeon who has encountered some of the difficulties and problems of facial surgery.

The section devoted to the discussion of harelip and cleft palate lacks somewhat in clearness by reason of its brevity. The illustrations portraying the results of operations for harelip show the excellent results the author has succeeded in attaining.

Two types of cases described by the author are particularly interesting: persistent edema of the lower eyelid successfully treated by the subcutaneous implantation of threads of bipped silk to favor lymphatic drainage and paralysis of the obicular oculi and oris due to injury of the seventh nerve corrected by transplantation of flaps from the temporal and masseter muscles.

SUMNER L. KOCH

**THE** volume by Stewart on skull fractures consists of eighty three roentgen ray studies which illustrate various fractures of the skull and those conditions which are commonly mistaken for skull fractures. These plates are accompanied by a brief description of the case history of the patient. They forcibly illustrate the absolute necessity for making an X ray study of the skull in every case of trauma to the head.

Any one who has listened to the testimony of doctors upon X ray pictures of the skull given before industrial compensation commissions could not refrain from wishing this book into the hands of each member of the industrial commission who arbitrates cases of injury involving injuries to the head. He might find it extremely helpful when good doctors disagree as to whether or not a normal blood vessel marking is a skull fracture. The dispositions of the skilled roentgenologist who is called upon to testify in such cases would certainly be preserved.

It is unfortunate that the reader cannot see the stereoscopic view of the plates shown in the text. Such a view adds a great deal to the ordinary flat plate. This volume is a distinct addition to the monographic atlases on roentgenographic subjects published by the *Annals of Roentgenology*.

LOYAL DAVIS.

SKULL FRACTURES. Roentgen Ray Studies. By Stewart, M.D., N.Y., and P. U. B. Hoebe, Inc., 1915.

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**FEEDING AND THE NUTRITIONAL DISORDERS IN INFANCY AND CHILDHOOD** By Julius H. Hess M.D. 4th ed. rev. Philadelphia: F. A. Davis Company 1925.

**AN INDEX OF TREATMENT** By Various Writers. Edited by Robert Hutchison M.D. F.R.C.P. and James Sherren C.B.E. F.R.C.S. 9th ed. rev. New York: William Wood and Company 1925.

**MALIGNANT DISEASE OF THE TESTICLE** By Harold R. Dew M.B. B.S. (Melbourne) F.R.C.S. (Eng.) F.A.C.S. London: H. K. Lewis & Co. Ltd. 1925.

**THE EARLY DIAGNOSIS OF THE ACUTE ABDOMEN** By Zachary Cope B.A. M.D. M.S. (Lond.) F.R.C.S. (Eng.) 3d ed. London and New York: Humphrey Milford Oxford University Press 1925.

**AN INTRODUCTION TO OBJECTIVE PSYCHOPATHOLOGY** By G. V. Hamilton M.D. Foreword by Robert M. Yerkes Ph.D. LL.D. St. Louis: The C. V. Mosby Company 1925.

**LA PRATIQUE CHIRURGICALE ILLUSTRÉE** By Victor Pauchet Fascicules VII and VIII. Paris: Librairie Octave Doin 1925.

**INTER AND THE LIGATURE** New Brunswick: New Jersey: Johnson & Johnson 1925.

**ON WRITING THeses FOR M.B. AND M.D. DEGREES** By Sir Humphry Rolleston Bart. F.R.C.B. (Hon.) D.Sc. (Oxford) D.C.L. (Durham) LL.D. (Glasgow and Bristol) 2d ed. rev. London: John Hall Sons & Danielsson Ltd. 1925.

**LE SINTI SPERIMENTAL** By G. Canali & J. Terracol. Paris: Masson et Cie 1925.

**A TEXTBOOK OF OBSTETRICS** By Thomas Watts Flen M.D. C.M. (Edin.) I.R.C.P. (Lond.) F.R.C.S. (Edin.) Maj. R.A.M.C. and Eardley H. Hand M.D. B.S. (Lond.) F.I.C.P. (Lond.) F.R.C.S. (Lond.) 6th ed. New York: The Macmillan Company 1925.

**LA SINDROME GASTRICA** By Dott. Antonio Cusi. Bologna: Licio Cappelli 1925.

**PLASTIC SURGERY OF THE NOSE** By J. Eastman Sheehan M.D. F.A.C.S. New York: Paul B. Hoeber 1925.

**SKULL FRACTURES** By William H. Stewart M.D. New York: Paul B. Hoeber 1925.

**SCRITTI MEDICI** By Mario Donati & others. Vols. I and II. Bologna: L. Cappelli 1925.

**MINOR SURGERY** By Lionel R. Fairfield I.R.C.S. (Eng.) New York: Paul B. Hoeber 1925.

**SELECTED PAPERS SURGICAL AND PATHOLOGICAL** By I. T. Paul D.N. Ch.M. F.R.C.S. (Eng.) London: Baillière Tindall and Cox 1925.

**ELIMINACIÓIN DE LA FIEBRE** By Tiburcio Padilla. Buenos Aires: La Semana Médica 1925.

**WILLIAM CAMPAN (His FATHER ON COLO)** By John Rubrah M.D. New York: Paul B. Hoeber 1925.

**A TEXTBOOK OF OPERATIVE ORTHOPEDICS** By A. Stein M.D. F.A.C.S. New York: D. Appleton and Company 1925.

**THE 1926 MEDICAL RECORD ABSTRACT LIST** WITH THE PROBLEMS OF MEDICAL EDUCATION. New York: The Rockefeller Foundation 1925.

**OTOLOGIC SURGERY** By Samuel J. Kopetzky M.D. F.A.C.S. New York: Paul B. Hoeber 1925.

**PYELITIS OF SURGERY** By Harold Burrows C.B.E. M.B. B.S. (Lond.) F.R.C.S. 2d ed. New York: William Wood and Company 1925.

**GYNECOLOGIE CHIRURGICALE GÉNITO STATIQUE** By C. Sobre Casas. Paris: Masson & Cie 1925.

**THE RADIOLOGICAL EXAMINATION OF THE MALE URETHRA** By G. I. S. Kohnstam M.R.C.S. (Eng.) I.R.C.P. (Lond.) and E. H. P. Cave M.B. B.S. (Lond.) F.R.C.S. (Eng.) L.R.C.P. (Lond.) D.M.R.E. (Cemb.) New York: William Wood and Company 1925.

**THE THERAPY OF PUERPERAL FEVER** By Privatdozent Dr. Robert Hoehder. American Edition prepared by Hugo Hutenfest M.D. F.A.C.S. St. Louis: The C. V. Mosby Company 1925.

**A TEXTBOOK OF PHYSIOLOGY** By William D. Zoethout Ph.D. 2d ed. St. Louis: The C. V. Mosby Company 1925.

**THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR** By Maj. Albert G. Love M.C. U.S. Army. Vol. 11—Statistics. Washington: The Government Printing Office 1925.

**AIDS TO SURGICAL DIAGNOSIS** By Cecil P. G. Wakeley I.R.C.S. New York: William Wood and Company 1925.

**SOME ENCOURAGEMENTS IN CANCER SURGERY** By C. Cicely Turner F.R.C.S. (Eng.) New York: William Wood and Company 1925.

**THORACIC SURGERY** By Howard Lilienthal M.D. F.A.C.S. Philadelphia & London: W. B. Saunders Company 1925. Vols. I and II.

**GEBURTSHEILFICHES BRIEFER FÜR ARZTE UND STUDIERENDE** By Dr. Franz Eberhart. Berlin: Urban & Schwarzenberg 1925.

**GYNECOLOGIE MÉDICALE LEÇONS CLINIQUES ET THÉRAPEUTIQUES SUR LES MALADIES DES FEMMES MALADIES DE L'OVULATION** By Paul Dalché. Paris: Vigot Frères 1925.

**POST MORTEM APPEARANCES** By Joan M. Ross M.B. B.S. (Lond.) M.R.C.S. L.R.C.P. New York: Oxford University Press 1925.

**ABDOMINAL AND PELVIC SURGERY FOR PRACTITIONERS** By Rutherford Monson (Hon.) M.A. & D.C.L. (Hon.) LL.D. M.B. F.R.C.S. (Edin. and Eng.) New York: Oxford University Press 1925.

**LEBERZENERGIE KANKINOM UND NAHRUNG EINE PHYSIOLOGISCHE CHEMISCHE HYPOTHESE ZUR ERKLÄRUNG DES DREIßIGSTEN PROBLEMS** By Dr. Med. O. L. E. DeRaadt. Leiden: S. C. Van Doesburgh 1925.

**L'ANATOMIE EN POCHES** By Victor Pauchet and S. Dupré. Paris: Gaston Doin 1926.

**Traitement des Épithéliomas du Maxillaire Supérieur** Par L'Association Chirurgicale Chréthérastie. Paris: Gaston Doin 1925.

**LA PRATIQUE DES DÉVIATIONS VERTÉBRALES (SCOLIOSE—CYPHOSE—LORDOSE)** By Carl Roederer and René Ledet. Paris: Gaston Doin 1926.

# AMERICAN COLLEGE OF SURGEONS

## THE 1925 SESSION OF THE CLINICAL CONGRESS

**T**HE fifteenth Clinical Congress of the American College of Surgeons met in Philadelphia beginning Monday October 26 and ending Friday October 30 1925 Those who were responsible for its organization both locally and generally are to be congratulated upon the remarkable success of this meeting

### MONDAY OCTOBER 26

The first session convened on Monday morning in the ballroom of the Bellevue Stratford with the president Dr Charles H Mayo of Rochester, in the chair It was a hospital conference and besides the number of interesting addresses by outstanding authorities in the hospital field the list of approved hospitals in the United States and Canada was presented by the Director General The meeting was continued throughout the afternoon

At 8 o'clock on Monday evening the ballroom was crowded to capacity for the formal opening of the Congress Dr Charles F Nassau chairman of the local committee on arrangements welcomed the Congress to the city of Philadelphia His address is given in full in pages immediately following this article

This was followed by the address of the retiring president Dr Charles H Mayo the induction of the new president Dr Rudolph Matas of New Orleans the address of the incoming president and the John B Murphy Oration in Surgery by Sir William Arbuthnot Lane Bart of London England These addresses all so interesting and so thoroughly appreciated are being published in detail in SURGERY GYNECOLOGY AND OBSTETRICS At the close of this meeting a moving picture film was shown illustrating the original work of Dr Matas on Surgery of the Blood Vessels

### TUESDAY OCTOBER 27

Those particularly interested in hospital matters were again gathered in a conference at the Bellevue Stratford on Tuesday morning and afternoon The clinics opened at the various hospitals with a full attendance everywhere On Tuesday at noon the distinguished guests and officials of the College were received at the City Hall

by His Honor The Mayor of Philadelphia The evening session in the ballroom of the Bellevue Stratford began promptly at 8 o'clock with a chalk and lantern demonstration by Dr Chevalier Jackson of Philadelphia<sup>1</sup> He was followed by Dr A Murat Willis of Richmond Virginia who spoke on The Mortality in Important Surgical Diseases Especially Appendicitis with discussions by Dr Damon B Pfeiffer and Dr John Stewart Rodman of Philadelphia Professor Vittorio Putti of Bologna Italy was greeted with a splendid ovation when he arose to speak on Congenital Dislocation of the Hip His paper was discussed by Dr Arthur Bruce Gill and Dr DeForest Willard of Philadelphia Dr Putti's motion picture film showing the results of his treatment was an able demonstration of his remarkable work

### WEDNESDAY, OCTOBER 28

The hospital conference on Wednesday in charge of the internists was an excellent meeting and gave definite proof of the fact that Hospital Standardization is not alone for the surgeon but, as well for those in other fields of professional practice

Special sessions for the section on eye ear nose and throat were held in the ballroom on Wednesday Thursday and Friday with interesting clinical demonstrations and papers This first meeting of the session was opened by Dr Philip Franklin of London England who exhibited a number of original slides of the Onodi Collection of Nasal Sinuses During the week clinics in eye ear nose and throat work were conducted at the various hospitals in Philadelphia

On Wednesday afternoon the University of Pennsylvania by special convocation conferred honorary degrees upon Lord Dawson of Penn England Dr Charles H Mayo of Rochester Minnesota and Dr Rudolph Matas of New Orleans Louisiana Another special feature of Wednesday's program was the outstanding clinic of Dr J Chalmers Da Costa conducted at the Jefferson Hospital This clinic was attended by a

<sup>1</sup>He and three of his principal papers read at the Clinical Congress will be published in SURGERY GYNECOLOGY AND OBSTETRICS

large and distinctive audience who paid personal tribute to the work of Dr. Da Costa.

The Wednesday evening program conducted in the ballroom included the following addresses: Dr. W. Blair Bell of Liverpool, England, on "The Treatment of Chronic Ascending Infections of the Uterus and Adnexa by the Bell Beutner Operation with Ovarian Conservation or Grafting," discussions by Dr. Barton Cooke Hirst and Dr. Brooke M. Ansper of Philadelphia; Dr. Arthur H. Curtis of Chicago on "Chronic Pelvic Infections: Deductions Resultant from a Combined Clinical and Laboratory Study," discussions by Dr. Charles C. Norris and Dr. P. Brooke Bland of Philadelphia and Dr. Robert C. Coffey of Portland, Oregon, on "The Principles of the Radical Treatment of Cancer of Pelvic Organs," discussion by Dr. John B. Deaver of Philadelphia.

#### THURSDAY, OCTOBER 29

Clinics were held on Thursday at the various hospitals. At 3 o'clock the annual meeting of the American College of Surgeons was held in the ballroom of the Bellevue Stratford. Dr. W. W. Chipman of Montreal was elected president; Dr. Clarence L. Starr, of Toronto, first vice president, and Dr. Charles F. Nassau of Philadelphia, second vice president. The following regents were elected for the term expiring in 1928: Dr. James B. Eagleston of Seattle; Dr. J. M. T. Finney of Baltimore; Dr. C. H. Mayo of Rochester; Dr. Robert E. McKechnie of Vancouver; and Dr. J. Bentley Squier of New York. Complete reports of the various departmental activities of the College were given at the annual meeting and will be published in the 1926 *Blue Book*.

The Thursday evening program began promptly at 8 o'clock with the president, Dr. Rudolph Matas, in the chair. A symposium on the "Rehabilitation of the Handicapped Surgical Patient" was participated in by a group of the younger surgeons as follows: Dr. George B. Lustermin; Dr. Donald C. Balfour; Dr. Hermon C. Bumpus; Dr. Verne C. Hunt; and Dr. Waltman Walters of Rochester, Minnesota; Dr. Robert S. Dinsmore of Cleveland; and Dr. Frank H. Lahey and Dr. Burton E. Hamilton of Boston. The program was closed with an interesting address on the "Use of Inulin in Surgery and Obstetrics" by Dr. F. N. C. Starr of Toronto. These papers were ably discussed by Dr. George P. Muller and Dr. John H. Jopson of Philadelphia.

#### FRIDAY, OCTOBER 30

Friday was the closing day of the Congress. Clinics took place at the various hospitals. At 11

o'clock in the morning the new candidates for Fellowship were assembled and given instructions as to the procedure of the Convocation. The evening session in the ballroom was one of the most impressive ceremonies ever held in connection with the Clinical Congress of the American College of Surgeons. The invocation was delivered by the Reverend John B. Laird of Philadelphia. Dr. Thierry de Martel of Paris, was present, and as a representative of the French Republic conferred upon Dr. Charles H. Mayo the Legion of Honor of France. In introducing Dr. de Martel, Dr. Matas spoke as follows:

The president has the pleasure to recognize the presence in this assembly of one of the most distinguished surgeons of France, an honorary Fellow of the College, a friend of America and of our institutions, and always a welcome guest of this College.

Dr. Thierry de Martel has come to us with a special mission from the government of the French Republic which he wishes to discharge on this auspicious occasion and in the presence of our assembled Fellows.

It is with pleasure that we will interrupt our proceedings to make room for Dr. de Martel, since he desires to honor the achievements of American surgery in the person of one of our Fellows—one whose name I need not mention now, but one whom we all love and who you will agree with your president is worthy of all the honors the world may choose to bestow upon him.

Fellowship degrees were conferred on the new candidates and honorary degrees upon the following distinguished guests: The Rt. Hon. Lord Dawson of Penn; Sir William Arbuthnot Lane; Bart. Dr. Philip Franklin, all of London, England; Dr. W. Blair Bell of Liverpool, England; and Professor Vittorio Putti of Bologna, Italy. One of the most pleasing features of the program was the conferring of honorary degrees upon two of the veteran surgeons of America: Dr. Frederic S. Dennis of New York, and Dr. William Henry Carmalt of New Haven.

The Fellowship address was delivered by Lord Dawson of Penn, personal physician to His Majesty the King of England. It was a masterly address and thoroughly appreciated by the large audience present. The president's introduction of Lord Dawson follows:

Medicine has given to the world many illustrious sons who throughout the ages have contributed to the intellectual and moral as well as to the material forces that have molded and advanced civilization. Philosophers, poets, artists, inventors, explorers, warriors, religious



leaders, politicians law givers statesmen, and others nursed in the bosom of medicine have led in the vanguard of progress. But of all the manifestations of versatility and genius which have been exhibited by medically trained men few can surpass in their immediate and direct value to the profession the men who endowed by nature with great vision directing and administrative faculties have put these to the profit of humanity through the instrumentality of medicine. These are the medical statesmen unfortunately too rare among us who combine a thorough and deep knowledge of their profession with a genius for political organization and governmental leadership. These men with opportunities and temptations to transfer their intelligence and special talents to the more glittering field of politics with its more decorative and power giving rewards choose to remain loyal and steadfast to their own profession while serving the highest interests of their profession and of the state in the realms of government. Medicine owes a great debt of gratitude to such leaders and no honor that we can bestow is too great to express our appreciation of the service they render toward the advancement of our profession.

Today the opportunity has come to us to demonstrate our admiration of a member of our profession who while serving the interests of his medical brethren in his own country, England has set an example that will surely profit us as it has his own people. He though one of the busiest and most responsible medical consultants in his own country has found time and energy to serve the collective interests of his profession as its spokesman and representative in the councils of his government. His ability and efficiency in this eminent capacity have given him celebrity as an inspiring medical statesman and leader which has

spread far beyond the boundaries of his own country. No one who is at all interested in the changes that are going on in medical education and medical practice in his country as in ours can fail to appreciate the great breadth of vision and firm grasp with which he has recently handled some of the most difficult problems of state medicine. His mastery of these is only equalled by his capacity to illuminate many of the obscure clinical and pathological problems of everyday medical practice.

In his dual capacity as physician to the social body and healer of corporeal ills Lord Dawson has proved himself not only the accomplished physician. Keen and learned in his profession but a contributor of extraordinary worth to its progress and welfare as a social collectivity. Further more by his acceptance of our honorary Fellowship he has symbolized the inseparable relations that bind the physician and the surgeon and he has testified to that unity of purpose that fuses the diversified activities of these into a mutual service for the common good.

A nobleman by title and royal prerogative he is a peer among Lords by the higher gifts that God gave him and by the nobility that is his through the love and admiration of his Fellows and this splendid doctor state man is the Rt. Honorable Lord Dawson of Penn. M.D. whom I have the honor to present to you.

The ceremony was closed with an enthusiastic interesting and instructive presentation of the ideals of modern surgery by the president where upon the new Fellows and their friends were received by the president the Board of Regents and distinguished guests. The Clinical Congress of 1925 left everyone with pleasant memories of an exceedingly profitable and entertaining week in the city of Philadelphia.

## ADDRESS OF WELCOME

BY CHARLES F. NASSAU, M.D., F.A.C.S., PHILADELPHIA  
Chairman, Committee for Congress

MR. PRESIDENT and Fellows of the American College of Surgeons. As chairman of your local committee on arrangements it affords me the very greatest pleasure to extend to you on behalf of my colleagues and myself and on behalf of the medical profession of Philadelphia and its institutions a cordial welcome to this

city the assurance of sincere hospitality and an attractive program which has been arranged for our fifteenth annual Congress. We trust that you may reciprocate the cordial goodwill of Philadelphia medical men find your participation in this Congress stimulating and instructive and that you will depart from this community having

profited by your visit as well as having gained a more intimate knowledge of its medical personnel, institutions traditions and history

It seems to me that on the very threshold at which a welcome is extended I may appropriately remind you that you now find yourselves in not only the Cradle of American Independence but the Cradle of American Medicine as well I make this statement to the end that you may embrace the opportunities of the next few days to gain a more intimate familiarity with the foundations of American medicine as well as to profit by the addresses and clinical demonstrations which have been arranged for this gathering

In focusing your attention for one brief moment upon certain epochal events and personalities I disclaim the indulgence of undue pride in the place of my residence education and labors and assume on your part an interest and pride in those medical achievements which have redounded to the credit of American medicine and belong to its history The accomplishments of Philadelphia and Philadelphians cover a wide range of medical activities scientific educational literary institutional and personal May I point out a few of them?

In 1730 Thomas Cadwalader delivered here the first public medical lectures and dissections given in America in 1742 he also made for purely scientific purposes the first postmortem examination and in 1745 he published (Benjamin Franklin printer) the first of our scientific contributions In these arid days it may be of mild passing interest to recall the title of the paper An Essay on the Essential Nature of the West India Dry Gripes The condition with which the paper dealt was as a matter of fact lead colic a frequently encountered affection in those lubulous times and was occasioned by the too liberal indulgence in the fashionable drink of the period a rum punch the rum having been distilled through lead pipes contained sufficient lead to cause the disorder known as the West India Dry Gripes

I may remind you of the founding of the two oldest hospitals in America—the Philadelphia Hospital in 1731 and the Pennsylvania Hospital in 1752 Benjamin Franklin was one of the organizers of the latter It was within its walls that Thomas Bord gave the first regular course of clinical instruction in America for the benefit of the medical profession In 1762 in the same place William Shippen Jr. offered the first systematic course of public lectures on anatomy and midwifery Three years later in 1765 his pedagogic ambitions found greater opportunities in a medical school established by him and John Morgan

and Benjamin Rush—now the Medical Department of the University of Pennsylvania the oldest medical school in America Benjamin Rush was the first really great American physician designated by Lettsom the Sydenham of America

Philadelphia early took the lead in medical authorship In 1775 John Jones a Philadelphia student published the first American treatise on surgery It is entitled 'Wounds and Fractures' and was almost the sole dependence of the surgeons of the Continental Army Members of the faculties of the two great medical schools later supplied the first American textbooks Among these each the first of its kind were Barton's *Materia Medica* 1798 Wistar's *Anatomy* 1811 Dorsey's *Surgery* 1813 Bard's *Obstetrics* Cote's *Medical Dictionary* 1808 and Eberle's *Practice of Medicine* 1829

Cote was also the founder of medical journalism in America

Still later in 1839 was Gross's book on *Pathological Anatomy* the first systematic contribution on that subject in America

It was here that the first United States Dispensary was compiled and published in 1835

Some of the other foundation stones of American medicine that may be mentioned are the first medical museum the Philadelphia Dispensary the first institution of its kind opened in April 1786 the first College of Pharmacy in America the organization of the American Medical Association in Philadelphia in 1847 with a Philadelphian Dr Nathaniel Chapman for its first president Dr Chapman was the originator of medical postgraduate instruction many years before

In a surgical retrospect we find much of interest Surgery flourished here from the beginning Philip Syng Physick is styled the father of American surgery as Marion Sims is deservedly called the father of gynecology It was here that the operation for the removal of vesical stone was first performed Not far from here Washington L. Atlee perfected a technique for ovariectomy and for the removal of uterine fibroids McClellan Pancoast Mütter Agnew Gross and Keen advanced both scientific knowledge and practical surgical technique in addition to their labors as great medical teachers John H. Drenton Philadelphia surgeon laid the foundation of the great Army Medical Museum of Washington

Still other Philadelphians who left their impress upon American medicine were John K. Mitchell who first clearly promulgated the germ origin and propagation of disease in his classic essay on The Cryptogamous Organ of Malaria Horatio C. Wood the father of American experimental phar-

macology Weir Mitchell, celebrated both in letters and medical science Joseph Leidy whose renown as a great naturalist and comparative anatomist spanned the ocean and gave lustre to his native city and to American science Jacob M DaCosta the greatest medical clinician and teacher of his time But I cease to mention by name although there are many others

Not only was the first medical school in America established here, but also the first medical college devoted to the education of women and to the exposition of the principles of homeopathy Jefferson Medical College has just completed one hundred years of honorable service and this year enters upon its second century

This city has educated and given to the service of the country and of the world not less than 42 000 physicians Until 1810 Philadelphia was the largest city in the United States and had been the most important from a financial commercial,

political artistic and scientific standpoint In 1810 there were but five medical schools in America with a total student body of 650 students and 100 graduates Two-thirds of these students were being educated in Philadelphia

The foregoing briefly and inadequately presents some of the historical background of Philadelphia and American medicine

You will have the opportunity to visit the institutions to which I have made brief reference and you will be received by the successors of some of those to whose achievements I have paid small tribute You will I believe find them worthily upholding the traditions of our medical forefathers in institutions which better than ever before further their objects and purposes

Again I extend to you a welcome on behalf of the medical profession of Philadelphia and wish for you the full realization of those expectations which have brought you to this shrine of American medicine

# SURGERY, GYNECOLOGY AND OBSTETRICS

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## SYMPOSIUM THE CARE OF THE HANDICAPPED SURGICAL PATIENT

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HERMON C. BOMBUS, M.D.

VERNE C. HUNT, M.D.

WALTMAN WALTERS, M.D.

## TREATMENT FOLLOWING OPERATIONS FOR ULCER OF THE DUODENUM AND STOMACH<sup>1</sup>

By GEORGE B. EUSTERMAN, M.D., ROCHESTER, MINNESOTA

Section: Medical and Surgical

WITH the marked increase in our knowledge of the physiological effects and complications of various diseases more active co-operation in treatment between the internist and surgeon is demanded. Surgical mortality has been reduced by the practical application to the pre-operative preparation of patients of the fruits of modern scientific research, particularly those of the biochemist and physiologist. This applies especially to operations in the presence of diabetes or cardiovascular disease, disease of the thyroid, kidneys or prostate, or of the biliary tract associated with jaundice and fast but not least gastro-intestinal lesions complicated by retention or obstruction and the resulting characteristic toxemia. The success achieved in this group by the pooling of our therapeutic resources is the best argument for future co-operation in other fields.

In the treatment of patients who have been operated on for benign lesions of the stomach

and duodenum the resources of the internist have not been sufficiently employed. Balfour has said that the internist should play a large part in making certain the good results that ought to follow proper surgical measures in suitable cases. In this connection the classification of dyspepsia into medical and surgical is unfortunate. There is no class of cases in which the close co-operation of internists and surgeons is more productive of results. In a recent interview Boas remarked that such an illogical classification only makes the internist cognizant of the failures of the surgeon, and conversely magnifies for the surgeon the failures of the physician. He felt that in America in particular there was evidence that the spirit of co-operation between these two big branches was being increasingly manifested.

The disappointments following gastric operation the late sequelae are interesting to study but sometimes difficult to avoid. The causes of them give the surgeon, clinician and

<sup>1</sup>Presented at the Clinical Congress of the American College of Surgeons, Philadelphia, Oct. 6-7, 1925.

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Section on Medicine 31 70 Clinic

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The disappointments following gastric operation the late sequelae are interesting to study but sometimes difficult to avoid. The causes of them give the surgeon clinician and

research worker food for much reflection and speculation. Fortunately such sequelæ are comparatively infrequent when a skillful operation has been performed under proper circumstances. Besides progress is being made in our knowledge of the causes, prevention and cure of recurrent lesions.

#### IMPORTANCE OF CAREFUL EXAMINATION

The chief cause of poor surgical results is the incomplete examination. There is a growing tendency to rely mainly on the results of a roentgenologic examination and to skimp or ignore the case history and gastric analysis. In the hands of the expert radiologist such procedure may reduce erroneous diagnoses and ill advised treatment to a minimum but the results of less skillful radiography may be highly unfavorable to both patient and surgeon. The operation based on an erroneous interpretation of the radiologic examination of the stomach is a potential factor for mischief. This error might be avoided by a careful marshalling of all the facts.

The high incidence of associated lesions of the accessory digestive tract in cases of peptic ulcer makes routine inquiry for evidence of disease in the appendix, gall bladder and pancreas essential for an incomplete operation is not an infrequent cause of incomplete cure. The results of gastric analysis are important from both a diagnostic and a surgical standpoint. Exclusive of gastric retention one of the most important disclosures of the test meal is achlorhydria or achylia. If present on a second examination by a fractional meal this secretory abnormality may connote various possibilities. The syndrome of ulcer may be simulated by so called achylia gastrica and I know of several such cases in which gastro-enterostomy was performed by competent surgeons with no relief or even with the addition of more disturbing symptoms. Anacidity in the presence of roentgenologic deformity characteristic of ulcer of the stomach or duodenum may postulate (1) an inactive healed malignant or syphilitic lesion (2) the association of one or various diseases ranging from chronic cholecystic disease to pernicious anemia or (3) an asthenic neurotic state coupled with a hypotonic or dilated stomach.

While surgical interference is imperative when the possibility of malignancy of a gastric ulcer arises when a duodenal ulcer is of the hæmorrhagic or perforative type or when there is evidence of associated disease of the gall bladder or appendix the secretory status would call for some procedure other than gastro-enterostomy. Excision, with or without pyloroplasty is to be preferred. It has been found necessary on several occasions to administer hydrochloric acid after gastro-enterostomy performed for duodenal ulcer on account of persistent primary subacidity. The mimicry of ulcer by other conditions functional and organic, the coincidence of other diseases and the fact that intrinsic gastric lesions constitute only a small percentage of the causes of dyspepsia make a complete clinical study imperative.

#### CASES SUITABLE FOR OPERATION

The surgical prognosis for the neurotic asthenic mentally or constitutionally inferior ulcer bearing patient is often poor especially if the symptoms of ulcer are not characteristic or are not in the foreground. My experience with the medical management of these patients has made me more sympathetic with the surgeon in his dealing with these post-operative complaints. Conservatism or a guarded prognosis in the event of an operation should be the rule. The young patient with a short uncomplicated history is usually not a good subject for operation and if his co-operation can be secured a course of careful medical treatment should first be tried. The small gastric ulcer of short duration without retention lends itself well to a course of medical treatment although the possibility of malignancy in elderly patients must always be borne in mind. While it may be a commentary on our shortcomings in diagnosis and treatment, it is a fact that most of our patients have a chronic indurated lesion with symptoms extending over an average period of 10 years and that complications have occurred singly or in combination in more than one third of them. In this large group operation is the *sine qua non* of treatment and medical measures should be employed only as complementary to surgical procedures or in

those cases in which there are serious contra indications to operation Ryle asserts that the most important contra indications to gastro jejunostomy are a short history well marked hypertonus, a high, abrupt curve of acidity, and rapid emptying and that the most reasonable indications for operation apart from obvious stenosis are a long history subnormal tonus a slowly climbing curve and slow emptying. I have been repeatedly impressed by how easily gastric acidity is brought under control or complete neutralization accomplished in some patients undergoing treatment in hospitals and how favorably they respond to gastro enterostomy and how in others the opposite results may obtain at least under treatment. This varying result with an increasing knowledge of variations in physiologic types gives great promise of informing the surgeon beforehand what type of surgical procedure is indicated and what the ultimate results will be.

#### POSTOPERATIVE CARE

*Clinical course* The necessity for post operative supervision in well selected cases is not great although in many instances a regulation of the mode of living and eating correction of certain habits or the eradication of infective foci is indicated. When symptoms do recur the nature and extent of postoperative care is usually dependent on their nature and severity. Of major importance are epigastric pain or distress nausea epigastric fullness regurgitation and vomiting and hemorrhage from whatever cause or source. Many of these symptoms singly or in combination may be engendered either by functional disturbances or organic lesions. In the former case they invariably resolve under medical supervision and treatment. The factors to be kept in mind are failure of the primary ulcer to heal or its reactivation irritation of the tissues about the stoma motor disturbances from mechanical causes and recurrent lesions which may also provoke motor impairment. The diagnostic factors furnished by the anamnesis clinical examination gastric analysis and radiologic examination are usually sufficient to determine the source of the complaint. In a recent study of 150 cases with secondary

or anastomotic ulcers it was shown that the symptoms resulting therefrom were usually similar to those provoked by the original lesion and had a tendency to assume identical histopathologic characteristics (13). It was also observed that the ulcer which gave rise to mild or vague symptoms with normal or subacid gastric contents, and which had a tendency to bleed invariably had its origin in focal infection. About half of these were not seen fluoroscopically and had a definite tendency to recur or continue to bleed after operation if the infective foci had not originally been eliminated.

*Dietetic principles* A proper dietetic regimen is essential to cure or relief in all types of intrinsic gastric disturbances. It appears to be a matter of common sense that a stomach handicapped by disease and the temporary trauma and disability imposed by operation should not be subjected to gastronomic insult. There is a disagreement of opinion as to the degree to which postoperative management should be carried out. Balfour believes that susceptible patients might develop functional digestive disturbances in exchange for the organic complaint when the postoperative treatment is too rigidly exacting. On the other hand one might rightfully argue that no supervision would be productive of greater mischief to the greater number. The obvious thing to do is to individualize treatment after a consideration of all the facts. There is no reliable evidence that adequate postoperative treatment has prevented recurrence or the formation of a gastrojejunal ulcer although it is reasonable to assume that it could. It may prevent and does relieve the more common disturbances of a functional nature. It is surprising how well patients have done with little or no restriction in diet or regulation of family habits of eating. In my opinion medical supervision for from 4 to 6 weeks at least after operation is important until complete healing has occurred and in the group in which postoperative sequelae might reasonably be expected.

Flint has shown in animals that the new formed anastomosis is the site of a healing ulcerated surface for about 2 weeks. Clinical experience repeatedly demonstrates that ul



ceration in the suture line, regardless of the type of operation, or at the gastrojejunal anastomosis, may appear shortly after operation. An intact gastric mucous membrane can tolerate much abuse but in the presence of ulceration or during the healing process a proper regimen may determine the ultimate success or failure of the surgical procedure. During the outpatient convalescent period it is not uncommon for uninstructed patients to eat large indigestible meals and suffer gastric retention. If this is promptly recognized and treated no harm is done but if not, much discomfort and considerable delay in recovery may ensue.

So far as is now known the second group which requires supervision consists of the young careless patients with hyperacid secretion but without gastric obstruction and the nervous worried hyperirritable, hard working male adults. A modified simple common sense regimen for all patients has two other advantages: it disarms criticism directed rightly or wrongly against surgeons for making short shrift of non surgical therapeutic methods and the ailing patient who has wilfully ignored his instructions or committed gross indiscretions will not lay all the blame on the surgeon and his art. In the clinic a booklet containing instructions of a general nature, the proper selection and preparation of food and suitable recipes has been found useful and time saving. In principle, the patient is advised to avoid highly seasoned, coarse and fried foods, condiments, tobacco, alcoholic stimulants and strong tea and coffee. To this may be added the present day slogan so applicable to the American public: Eat half as much and twice as long.

#### INDICATION FOR THE USE OF ALKALIS

The importance of persistent or recurring hyperacidity in cases of postoperative morbidity is just beginning to be appreciated. Clinical hyperacidity or hypersecretion or both are present in most cases of ulcer, especially during the period of active symptoms. Carlson has demonstrated its unfavorable influence on the function of the pylorus and duodenum in provoking undue spasm and contraction and thereby aggravating the symptoms characteristic of ulcer in its pres-

ence. Sippy has called attention to the association of delayed emptying and excessive continued secretion with recurrence after gastroenterostomy. Internists and surgeons alike have stressed the highly probable causal relation of hyperacidity to recurrent ulcer. Recent contributions by Hurst, Bolton and Goodhart, Sherren and Walton have emphasized this relation. Experimental proof is not lacking. By diverting the alkaline secretions which neutralize the gastric juice, Mann and Williamson were able to produce typical subacute or chronic peptic ulcer in a high percentage of animals, comparable pathologically to that found in man. In more recent experiments Mann has shown that if the ulcer is protected from contact with the gastric juice, healing is complete and reasonably rapid. By the judicious use of alkalis the pain and acidity of peptic ulcer can be controlled especially when a proper diet and rest are also employed. There is clinical and experimental evidence that alkalis exert a healing influence. Dr. Moxstedt and Vaughn produced experimental ulcers in dogs, many of which failed to heal normally because of the persistent irritant effect of non absorbable sutures. When alkalis were administered in amounts sufficient to neutralize gastric secretion the lesion promptly healed. Besides their neutralizing effect, alkalis decrease gastric tonus, inhibit regional spasm in the presence of ulcer and partly immobilize the pylorus. The xymographic studies of Joseph and Hardt have shown further the inhibitory effect of alkalis and frequent feeding on gastric tonus, peristalsis and acidity. Thus we have a sound clinical and physiologic basis for the postoperative use of alkalis under definite conditions. For routine purposes a combination of calcined magnesia and bismuth subcarbonate in doses of 10 and 15 grains respectively from 1 to 2 hours after meals with a quarter of a glass of water is recommended. A glass of rich milk may be taken an hour thereafter or may be combined with the powder. The dose may be increased or reduced and sodium bicarbonate and calcium carbonate substituted or alternated according to indications. A certain amount of caution is necessary as alkalis in unnecessarily large doses may cause gastric irritation or a

tendency to alkalosis as emphasized by Hardt and Rivers

#### UNFAVORABLE EFFECT OF TOBACCO

The excessive use of tobacco is deleterious to the health of the patient with peptic ulcer. In those susceptible to the influence of nicotine moderate amounts may be harmful. The patient who craves tobacco invariably consumes excessive amounts and the habit should be discouraged. Langley showed that nicotine paralyzes the synapses of the sympathetic nervous system so that dyspeptic symptoms in habitual smokers are logical, owing to unopposed vagal action. Wagner concluded from a recent investigation that all the subjective and roentgenologic signs of duodenal ulcer can be produced by the excessive use of tobacco. During the last decade the typical syndrome of peptic ulcer has been occasionally observed in young adults given to excessive cigarette smoking and their discomforts have disappeared largely through the discontinuance of the habit. Moynihan is convinced that smoking is a harmful habit under the circumstances that an attack of duodenal ulcer often follows an orgy of tobacco and that abstinence may check such an attack. German clinicians are loath or refuse to accept for treatment the patient with peptic ulcer whose fingers are tobacco stained. I have frequently noticed the peculiar psychologic fact that patients of physicians who are inveterate smokers are not as a rule warned to discontinue or restrict the use of tobacco.

The definitely better end results that are obtained in either the surgical or non surgical treatment of ulcer in women should furnish a therapeutic hint and justification for post operative precautions. While factors of an anatomic physiologic and occupational nature may play a part I feel that such greater success is due more to their whole hearted and continued co operation regarding matters of diet and mode of eating and to the fact that generally speaking they are not handicapped by the excessive use of tobacco and alcohol.

#### FACTORS PROVOKING HÆMORRHAGE

Exact determination of the cause and source of hæmorrhage from the upper diges-

tive tract is often extremely difficult. The effect of extragastric conditions is not generally appreciated. While it is important to exclude a lesion of the stomach or duodenum in every instance of hæmorrhage the fact remains that chronic intrinsic lesions are not found in the majority of all patients with hæmatemesis or melæna. It is true that when the hæmorrhage is the result of a bleeding ulcer its complete removal insures against further hæmorrhage unless extrinsic conditions are also present which may give rise to hæmorrhage such as cirrhosis of the liver, chronic cholecystic disease with or without hepatitis, hæmophilia and splenic disease. I have recently observed that unusual exertion or an alcoholic debauch by patients with ulcer or conditions extrinsic to the stomach which may provoke gastro enteric hæmorrhage, is likely to be followed by hæmorrhage. I could cite a number of interesting case records to prove this point. Patients for whom gastro enterostomy has been successfully performed for bleeding ulcer may after years of complete health have another hæmorrhage the result of such unaccustomed exertion as cranking a car in cold weather, felling a large tree, driving forty or fifty golf balls during practice, or strenuous hunting. An alcoholic debauch may have the same effect. Instances are also on record of patients who have had symptoms of peptic ulcer for a long time but without hæmorrhage experiencing a hæmorrhage after the injudicious use of alcohol, especially the moon shine brand. The last instance of severe hæmorrhage and anaemia following exertion that I saw was in a dyspeptic patient who at operation had chronic cholecystitis and hepatitis without a demonstrable lesion in the stomach or duodenum.

#### SUMMARY

The co operation of internist and surgeon in the pre operative preparation of patients has strikingly reduced the surgical mortality in various types of diseases. A similar pooling of therapeutic resources after operation should reduce surgical morbidity to a minimum. Pre operative factors enhancing surgical end results in cases of benign gastroduodenal lesions are their proper selection both from a general and a special standpoint and the com-

ceration in the suture line regardless of the type of operation, or at the gastrojejunal orifice may appear shortly after operation. An intact gastric mucous membrane can tolerate much abuse but in the presence of ulceration or during the healing process a proper regimen may determine the ultimate success or failure of the surgical procedure. During the outpatient convalescent period it is not uncommon for uninstructed patients to eat large indigestible meals and suffer gastric retention. If this is promptly recognized and treated no harm is done but if not much discomfort and considerable delay in recovery may ensue.

So far as is now known the second group which requires supervision consists of the young careless patients with hyperacid secretion but without gastric obstruction and the nervous worried hyperirritable hard working male adults. A modified simple common sense regimen for all patients has two other advantages: it disarms criticism directed rightly or wrongly against surgeons for making short shrift of non surgical therapeutic methods and the ailing patient who has wilfully ignored his instructions or committed gross indiscretions will not lay all the blame on the surgeon and his art. In the clinic a booklet containing instructions of a general nature, the proper selection and preparation of food and suitable recipes has been found useful and time saving. In principle the patient is advised to avoid highly seasoned coarse and fried foods condiments tobacco alcoholic stimulants and strong tea and coffee. To this may be added the present day slogan so applicable to the American public: Eat half as much and twice as long.

#### INDICATION FOR THE USE OF ALKALIS

The importance of persistent or recurring hyperacidity in cases of postoperative morbidity is just beginning to be appreciated. Clinical hyperacidity or hypersecretion or both are present in most cases of ulcer especially during the period of active symptoms. Carlson has demonstrated its unfavorable influence on the function of the pylorus and duodenum in provoking undue spasm and contraction and thereby aggravating the symptoms characteristic of ulcer in its pres-

ence. Sippy has called attention to the association of delayed emptying and excessive continued secretion with recurrence after gastroenterostomy. Internists and surgeons alike have stressed the highly probable causal relation of hyperacidity to recurrent ulcer. Recent contributions by Hurst, Bolton and Goodhart, Sherren and Walton have emphasized this relation. Experimental proof is not lacking. By diverting the alkaline secretions which neutralize the gastric juice, Mann and Williamson were able to produce typical subacute or chronic peptic ulcer in a high percentage of animals comparable pathologically to that found in man. In more recent experiments Mann has shown that if the ulcer is protected from contact with the gastric juice healing is complete and reasonably rapid. By the judicious use of alkalis the pain and acidity of peptic ulcer can be controlled especially when a proper diet and rest are also employed. There is clinical and experimental evidence that alkalis exert a healing influence. Dr. A. J. Stead and Vaughn produced experimental ulcers in dogs many of which failed to heal normally because of the persistent irritant effect of non absorbable sutures. When alkalis were administered in amounts sufficient to neutralize gastric secretion the lesion promptly healed. Besides their neutralizing effect alkalis decrease gastric tonus, inhibit regional spasm in the presence of ulcer and partly immobilize the pylorus. The kymographic studies of Joseph and Hardt have shown further the inhibitory effect of alkalis and frequent feeding on gastric tonus, peristalsis and acidity. Thus we have a sound clinical and physiologic basis for the postoperative use of alkalis under definite conditions. For routine purposes a combination of calcined magnesia and brometh subcarbonate in doses of 10 and 15 grains respectively from 1 to 4 hours after meals with a quarter of a glass of water is recommended. A glass of rich milk may be taken an hour thereafter or may be combined with the powder. The dose may be increased or reduced and sodium bicarbonate and calcium carbonate substituted or alternated according to indications. A certain amount of caution is necessary as alkalis in unnecessarily large doses may cause gastric irritation or a

tendency to alkalosis as emphasized by Hardt and Rivers

#### UNFAVORABLE EFFECT OF TOBACCO

The excessive use of tobacco is deleterious to the health of the patient with peptic ulcer. In those susceptible to the influence of nicotine moderate amounts may be harmful. The patient who craves tobacco invariably consumes excessive amounts and the habit should be discouraged. Langley showed that nicotine paralyzes the synapses of the sympathetic nervous system so that dyspeptic symptoms in habitual smokers are logical, owing to unopposed vagal action. Wagner concluded from a recent investigation that all the subjective and roentgenologic signs of duodenal ulcer can be produced by the excessive use of tobacco.

During the last decade the typical syndrome of peptic ulcer has been occasionally observed in young adults given to excessive cigarette smoking and their discomforts have disappeared largely through the discontinuance of the habit. Moynihan is convinced that smoking is a harmful habit under the circumstances that an attack of duodenal ulcer often follows an orgy of tobacco and that abstinence may check such an attack. German clinicians are loath or refuse to accept for treatment the patient with peptic ulcer whose fingers are tobacco stained. I have frequently noticed the peculiar psychologic fact that patients of physicians who are inveterate smokers are not as a rule warned to discontinue or restrict the use of tobacco.

The definitely better end results that are obtained in either the surgical or non surgical treatment of ulcer in women should furnish a therapeutic hint and justification for post operative precautions. While factors of an anatomic physiologic and occupational nature may play a part I feel that such greater success is due more to their whole hearted and continued co operation regarding matters of diet and mode of eating and to the fact that generally speaking they are not handicapped by the excessive use of tobacco and alcohol.

#### FACTORS PROVOKING HÆMORRHAGE

Exact determination of the cause and source of hæmorrhage from the upper diges-

tive tract is often extremely difficult. The effect of extragastric conditions is not generally appreciated. While it is important to exclude a lesion of the stomach or duodenum in every instance of hæmorrhage the fact remains that chronic intrinsic lesions are not found in the majority of all patients with hæmatemesis or melena. It is true that when the hæmorrhage is the result of a bleeding ulcer, its complete removal insures against further hæmorrhage unless extrinsic conditions are also present which may give rise to hæmorrhage such as cirrhosis of the liver, chronic cholecystic disease, with or without hepatitis, hæmophilia and splenic disease. I have recently observed that unusual exertion or an alcoholic debauch by patients with ulcer or conditions extrinsic to the stomach which may provoke gastro enteric hæmorrhage, is likely to be followed by hæmorrhage. I could cite a number of interesting case records to prove this point. Patients for whom gastro enterostomy has been successfully performed for bleeding ulcer may after years of complete health have another hæmorrhage the result of such unaccustomed exertion as cranking a car in cold weather, felling a large tree, driving forty or fifty golf balls during practice or strenuous hunting. An alcoholic debauch may have the same effect. Instances are also on record of patients who have had symptoms of peptic ulcer for a long time but without hæmorrhage experiencing a hæmorrhage after the injudicious use of alcohol, especially the moon shine brand. The last instance of severe hæmorrhage and anæmia following exertion that I saw was in a dyspeptic patient who at operation had chronic cholecystitis and hepatitis without a demonstrable lesion in the stomach or duodenum.

#### SUMMARY

The co operation of internist and surgeon in the pre operative preparation of patients has strikingly reduced the surgical mortality in various types of diseases. A similar pooling of therapeutic resources after operation should reduce surgical morbidity to a minimum. Pre-operative factors enhancing surgical end results in cases of benign gastroduodenal lesions are their proper selection both from a general and a special standpoint and the com-

plete examination of the patient. It is predicted that our increasing knowledge concerning physiologic gastric types and their variations and mode of response to treatment will furnish criteria for the proper selection of the operation. The patient who has been well chosen and skillfully operated on invariably does well without any exact postoperative regimen. Recurrent ulcers, while infrequent with experienced surgeons, as a rule give rise to symptoms similar to those provoked by the original lesion and tend to assume identical histopathologic characteristics. The use of proper diet, alkalis, frequent feedings, and so forth immediately after operation for about 6 weeks at least, and for a longer period in certain types of cases, rests on sound experimental and clinical ground. The better end results in the medical or surgical treatment of ulcer in women than in men are largely due to their superior personal and eating habits and better co-operation in general. The habitual or excessive use of tobacco is harmful to the patient with peptic ulcer. In such patients gastroenteric hæmorrhage may be provoked by the abuse of alcoholic drinks or unusual exertion.

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FUNDAMENTAL PRINCIPLES IN SURGERY OF THE STOMACH AND DUODENUM, REPORT OF FOUR HUNDRED CASES<sup>1</sup>

By DONALD C BALFOUR MD FACS ROCHESTER MINNESOTA

SINCE January 1924 a certain routine has been followed at the Mayo Clinic in the management of patients with serious or complicated lesions of the stomach or duodenum, particularly carcinoma of the stomach recurring peptic ulcer and pyloric obstruction. More intensive study and pre-operative preparation of such patients by the gastroenterological staff has added very definitely to the efficiency of their treatment and has made more exact and safer operations possible. My own experience with observing such patients in the hospital pre-operatively in conjunction with the gastroenterological staff has been so gratifying that I wish to report a series of 400 consecutive operations for lesions of the stomach and duodenum which were done in a period of 15 months following the establishment of this practice.

## OPERATIVE MORTALITY

In this series of 400 cases there were 4 operative deaths: 1 from bronchopneumonia 10 days after a difficult partial gastrectomy for advanced carcinoma involving the pancreas the resection having been advised under taken as a palliative measure to relieve obstruction; 1 from acute pancreatitis following partial gastrectomy for multiple gastrojejunal ulcers associated with subacute pancreatitis; 1 from the extension of a retroperitoneal infection into the general peritoneal cavity 10 days after excision of a large bleeding duodenal ulcer of the posterior wall and followed by gastroenterostomy in a patient with marked secondary anemia; and 1 following jejunotomy for a large subacute perforating ulcer at the cardia in a patient whose condition was so bad that even this operation was questionably advisable (Table 1).

I have recently emphasized the importance and value of co-operation between internist and surgeon in the care of such cases.<sup>2</sup> particu-

<sup>1</sup> See also D. C. Balfour, "Co-operation between internist and surgeon in the management of complicated gastric and duodenal ulcers," J. Am. M. Ass., 1925, 35: 1222-1225.

<sup>2</sup> Presented at the Clinical Congress of the American College of Surgeons, Philadelphia, October 6-10, 1925.

TABLE I—CLASSIFICATION

Disease	Cases	Hospital mortality
Gastric carcinoma	113	1
Gastric ulcers		
Chronic and subacute	49	1
Acute perforating	2	
Recurring	7	
Duodenal ulcers		
Chronic and subacute	146	1
Recurring	15	
Combined gastric and duodenal ulcers	13	
Gastrojejunal ulcers	22	1
Carcinoma of duodenum	1	
Sarcoma of stomach	1	
Syphilis of stomach	2	
Benign tumors of stomach	2	
Malfunctioning or unnecessary anastomosis	10	
Miscellaneous (pylorospasm, pyloric obstructions and so forth)	17	
Total	400	4

larly those in which complications either increase the difficulty of interpretation or the risk of operation or both. Care of patients in the hospital before operation is the keynote of the successful management of these cases. The advantages of this preliminary treatment being of particular value for patients with obscure or complicated disorders, for patients with recent gastro-intestinal hemorrhages for patients who have had previous (often multiple) operations on the stomach and duodenum for patients with ulcers showing recent exacerbations and extension of inflammatory products for patients with gastric carcinoma for patients with gastric obstruction and retention and in general for patients in poor physical condition. The careful pre-operative preparation of such patients has been of extraordinary aid in determining the indications for surgical procedure, the optimal time for it, and in making it possible to perform safely difficult technical operations when the surgical risk was great. Equally careful supervision must be maintained during convalescence.

**Anesthesia** The danger from pulmonary complications following upper abdominal

operations is well known, but recent developments in anesthetics have apparently aided in definitely diminishing the incidence of such complications. In this series of cases ethylene has been the general anesthetic combined when necessary with novocain to produce block anesthesia or sufficient ether to give satisfactory relaxation. Morphine  $1/6$  grain and atropine  $1/150$  grain have been given as a routine half an hour before operation. The almost total absence of pulmonary morbidity and the low mortality in 400 operations on the stomach and duodenum 113 of which were for carcinoma, more than suggest the advantages of ethylene in these cases at least. The two disadvantages of ethylene are its inflammability and the difficulty of efficient administration. The former is not a menace if reasonable care is exercised and the latter can be overcome by experience. Lundy has recently introduced into the Mayo Clinic a combination of carbon dioxide with ethylene which is more effective than ethylene alone.

#### SURGICAL AIDS

There are certain points with regard to surgery of the stomach and duodenum which are always worthy of repetition. The first is adequate exposure in which long incisions usually in the left rectus and self retaining retractors and packs are valuable aids. The second is adequate mobilization. This applies particularly to large gastric ulcers adherent posteriorly. It is frequently possible by methodical mobilization of the stomach to carry out satisfactorily partial gastrectomy or excision when the ulcer is situated so high that on first impression it appears to be irremovable. The third point is absolute hemostasis. This can always be secured if scrupulous care is taken in the ligation of individual vessels and in the placing of sutures. The fourth point is the importance of avoiding incomplete operations since a primary radical operation can often be performed with no more risk than an incomplete one or one intended as the first of a two-stage procedure. Another very useful adjunct is the suction pump. I have made it a routine to empty the stomach completely before finishing the operation and often to empty and collapse the distended

stomach with the pump before beginning the mobilization as suggested by Devine. Finally there must be a proper appreciation of the mechanics of whatever operation is being performed, that is the restoration of gastrointestinal continuity in such a way that adequate drainage is secured. Trauma should be kept at a minimum.

#### POSTOPERATIVE CARE

In the postoperative care rest of the stomach and upper intestinal tract are of first importance. The more extensive the operation the longer should this rest be maintained. For example in cases of complicated resection fluids by mouth are withheld for as long as 4 days the proper fluid balance being maintained by proctoclysis hypodermoclysis or intravenous administration. When stimulation is needed coffee given by proctoclysis is satisfactory. The unrestricted employment of the stomach tube is of great importance. Retention of secretions is not permitted whenever uncertainty exists the tube should be passed. A quick pulse and anxious faces may be entirely due to retention. The prompt recognition of complications and their prompt control are vital. The early detection by studies of the chemistry of the blood of the toxemia of high gastro-intestinal obstruction and its control by the intravenous administration of physiological sodium chloride and glucose solutions are now well appreciated.

#### OPERATIONS

The duodenal ulcers in the series have usually been of the type suitable for gastroenterostomy (Table II) there appeared to be relatively few cases in which a direct attack on the ulcer was called for. There were 18 cases in which usually because of hemorrhage it seemed advisable to adopt a more radical procedure than simple gastro-enterostomy. The procedure in such cases rests with the surgeon the excision and pyloroplasty of Finney Horsley C. H. Mayo and Judd, being outstanding in value. In 4 cases of duodenal ulcer partial gastrectomy and duodenectomy were employed. While it is difficult to understand the rationale of partial gastrectomy as a primary operation for chronic duodenal ulcer

it is nevertheless imperative in view of the enthusiasm of continental surgeons for such radical treatment to investigate its possibilities. Although the operation entails but little more risk than gastro-enterostomy this fact alone does not recommend it and it is doubtful whether the end results will show that it has any superiority over less mutilating procedures. There is already evidence of a reaction against the removal of a large part of a healthy stomach as an indirect method of treating a benign lesion not in the stomach.

TABLE II—OPERATIONS FOR DUODENAL ULCER AND ITS COMPLICATIONS

Types of operation	Cases	Hospital mortality
Partial gastrectomy and duodenectomy	4	
Partial gastric exclusion (Devine)	4	
Posterior gastro-enterostomy	142	
Antecolic posterior gastro-enterostomy	1	
Excision with or without gastro-enterostomy or gastroduodenostomy	9	1
Dissection of the anastomosis excision pyloroplasty	1	
Total	161	1

Retention vomiting following gastro-enterostomy is rare since mechanical difficulties are practically eliminated if the operation is indicated the opening is of sufficient size the proximal loop of the jejunum is long enough and the anastomosis hangs well below the mesocolic opening. If regurgitant vomiting should occur it is usually controlled by systematic gastric lavage and if necessary intravenous medication to maintain body fluids.

**Gastric ulcer.** It is apparent that partial gastrectomy is becoming more and more the operation of choice in cases of chronic gastric ulcer (Table III). The operation is safe and complete removal of the lesion is insured. Another advantage worthy of note is that the removal of multiple ulcers is also insured. These are more common than has been believed and undoubtedly supposed recurrences following excision and gastro-enterostomy have been lesions that were not removed at operation because they were not detected at that time. The tendency of gastric ulcer to become malignant has been shown with such certainty in some of these cases that attempts to deprecate the danger of this tendency are both unnecessary and unwise. It is still not

realized that gastric ulcer is a rare disease, and the frequency with which such a diagnosis is made particularly in women may explain why certain observers believe that only a small percentage of them develop into malignant processes.

While partial gastrectomy is the method of choice in cases of chronic gastric ulcer local excision by knife or cautery combined with gastro-enterostomy remains the most satisfactory and the most reasonable procedure for the small lesion which can be accurately mobilized. Ulcers attached posteriorly should whenever possible be at least detached and the edges of the opening excised or destroyed with cautery since indirect operation alone will relieve symptoms in only a small percentage of cases and the danger of subsequent malignant change is a very real one.

TABLE III—OPERATIONS FOR GASTRIC ULCER AND ITS COMPLICATIONS

Types of operation	Cases	Hospital mortality
Partial gastrectomy	29	
Posterior gastro-enterostomy	1	
Excision (knife or cautery) and posterior gastro-enterostomy	18	
Knife excision	1	
Closure perforation and drainage	1	
Anterior gastro-enterostomy entero-anastomosis	1	
Jejunostomy	1	
Total	58	1

It should be remembered however that gastro-enterostomy alone can be depended on in a certain percentage of cases to promote healing of the ulcer and consequent relief from symptoms. The case of a young woman 27 years of age who had a typical syndrome of gastric ulcer of the hæmorrhagic type illustrates this point. At operation the lesion with a crater 4.5 centimeters in diameter was found on the posterior wall of the cardiac end of the stomach with a broad attachment to the pancreas. It was quite obviously unwise to attempt removal as it would have necessitated almost total gastrectomy, and posterior gastro-enterostomy only was performed. Six months later the patient returned the peptic ulcer pain having gradually disappeared. An X-ray examination showed no evidence of a lesion.

Of the 57 cases in this group there were 10 with multiple ulcers and 3 with hour glass



operations is well known but recent developments in anesthetics have apparently aided in definitely diminishing the incidence of such complications. In this series of cases ethylene has been the general anesthetic combined when necessary with novocain to produce block anesthesia or sufficient ether to give satisfactory relaxation. Morphine 1/6 grain and atropine 1/150 grain have been given as a routine half an hour before operation. The almost total absence of pulmonary morbidity and the low mortality in 400 operations on the stomach and duodenum 213 of which were for carcinoma, more than suggest the advantages of ethylene in these cases at least. The two disadvantages of ethylene are its inflammability and the difficulty of efficient administration. The former is not a menace if reasonable care is exercised and the latter can be overcome by experience. Lundy has recently introduced into the Mayo Clinic a combination of carbon dioxide with ethylene which is more effective than ethylene alone.

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TABLE V — OPERATIONS FOR RECURRING ULCER AND ITS COMPLICATIONS

	Case	Spontaneous cure
Duodenal ulcer		
Resection	2	
Posterior gastro-enterostomy	11	
Excision and gastroduodenostomy	1	
Disconnection of the anastomosis following gastro-enterostomy excision of scar pyloroplasty	1	
Gastric ulcer		
Resection	5	
Excision and pyloroplasty	1	
Posterior gastro-enterostomy	1	
Gastrojejunal ulcer (including gastrojejunal fistula)		
Resection	16	1
Disconnection of the anastomosis following gastro-enterostomy posterior gas tro-enterostomy	1	
Disconnection of the anastomosis following gastro-enterostomy with or without excision of ulcer and pyloroplasty	3	
Total	44	1

and duodenum the surgeon is necessarily interested in getting a safe approximation and may therefore not resect the growth as widely as when such a consideration does not enter into the problem. If recurrence does take place it usually occurs in the line of anastomosis probably with resulting obstruction.

It may be of interest that chromicized catgut was employed for all sutures two rows being placed posteriorly and three anteriorly. Particular attention has been paid to emptying the stomach thoroughly by suction just before the anastomosis is closed.

The relation of carcinoma to ulcer is well shown by the history of a patient aged 55 years who had had stomach trouble for 15 years. The history was typical of peptic ulcer in its periodicity and in the relation of pain to food. Two months before examination at the clinic the patient had vomited coffee ground material and had developed symptoms of partial obstruction. During these 2 months he had lost 20 pounds. Examination of gastric contents showed total acids 70 and free hydrochloric acid 50. A clinical diagnosis of ulcer of the stomach was made. Exploratory operation revealed an ulcer of the posterior wall about 2 centimeters in diameter attached to the pancreas. Resection was performed and the patient recovered uneventfully. The pathologist reported early car-

TABLE VI — PARTIAL GASTRECTOMY

Diagnosis	Cases	Mortality
Carcinoma	46	5
Gastric ulcer	9	
Duodenal ulcer	4	
Combined gastric and duodenal ulcers	9	
Recurring duodenal ulcer	2	
Recurring gastric ulcer	5	
Gastrojejunal ulcer	16	1
Sarcoma of the stomach	1	
Hypertrophy of the pylorus	1	
Malfunction of the anastomosis following gastro-enterostomy	1	
Total	114	2

cinomatous degeneration. A year later the patient returned having had several months of complete relief from his gastric symptoms but he had recently noticed a loss of weight with loss of appetite. On examination he was found to have multiple carcinomatous nodules on the abdominal wall with ascites and abdominal carcinomatosis.

*Recurring peptic ulcer.* Recurring peptic ulcer although relatively rare following the proper surgical treatment is nevertheless an important phase of peptic ulcer because of the failure of surgery to bring about permanent cure and because of the difficulties surrounding the cause prevention diagnosis and management of the complication. The scope of this paper will not permit any detailed discussion of ulcers of this type but it should be said that if the primary operation is properly carried out is based on adequate indications and the patients make a reasonable effort at co-operation in their habits of living after the operation recurrences will be so few that one will hesitate to depart from the methods of surgical management which have been in vogue for so many years. Recurrence may and does of course follow any type of operation including partial gastrectomy. In this series there were 44 operations for recurrences (Table V) 21 of these were at the point of gastroenteric anastomosis 7 were in the stomach (6 following gastro-enterostomy and 1 following gastroduodenostomy) and 15 were in the duodenum (7 following a closure of an acute perforation 4 following an excision of the ulcer and gastroduodenostomy 2 following gastro-enterostomy and 2 in which the details of the previous operations could not be determined).

contraction. In practically all cases the ulcer was situated on the posterior wall near the lesser curvature. There were only 2 cases in which the ulcer was not removed either by excision or by partial gastrectomy removal being accomplished therefore in 83 per cent. One case in which the ulcer was not excised was that of a patient, aged 75 years who had a high grade pyloric obstruction. He had been operated on previously for an acute perforating ulcer. Relief from the obstruction was the urgent indication and apparently nothing was to be gained from a resection of the indurated area at the pylorus. The other cases in which an indirect operation alone was done were more or less similar; that is, large posterior ulcers situated high in the stomach and associated with such extensive perigastritis and thickening of the gastric wall that even had the general condition of the patient been satisfactory only the indirect operation would have been justifiable.

The one death in the series of cases of gastric ulcer might reasonably be attributed to some other cause than the operation for ulcer since the condition of the patient and the size and character of the lesion made any operation for the ulcer out of the question. As the patient was rapidly failing because of his inability to eat a jejunostomy was done in the hope that by feeding for several weeks through the tube improvement would be sufficient so that operation for the ulcer could be performed. The operation was performed under local anesthesia and the patient recovered from it but at the end of a week he developed bronchopneumonia. Because of his low resistance he did not recover.

**Gastric carcinoma.** The surgical management of carcinoma of the stomach involves many important phases and only some of the more practical ones will be considered here. First it should be noted that the percentage of resectability is about the same in recent cases as it has been in earlier cases in the clinic, namely 42. Since it is the practice in the clinic if the patient desires it to perform an exploratory operation for carcinoma of the stomach without evidence of metastasis and the total number of operations included an unusually large number of

explorations a rate of resectability of 42 per cent is not low. This rate is only attained by performing a certain number of rather questionable resections and in some cases of this series it seems almost necessary to apologize for attempting resection because the disease was so advanced. If however one is governed by the wish of the patient and follows the Golden Rule occasional extensive resections for advanced carcinoma are inevitable. Experience has shown that some of these patients have remained well and free from recurrence. Again partial gastrectomy may be undertaken as a purely palliative measure that is in the presence of known metastasis the growth being resected for actual or impending obstruction. Since resections have been performed on patients with all stages of involvement a series in which partial gastrectomy was performed 46 times for carcinoma with 2 deaths shows how safely such operations can be carried out (Table IV).

It will be noted that gastro-enterostomy was performed comparatively rarely in cases of gastric carcinoma. Gastro-enterostomy for advanced carcinoma seldom gives sufficient palliation to make it worth while, and is often disappointing from every standpoint. All the resections were done in one stage however, a two stage operation as pointed out by Cline is occasionally of value.

TABLE IV—OPERATIONS FOR GASTRIC CARCINOMA

Type of case	Cases	Hospital mortality
Partial gastrectomy	46	1
Exploration	48	
Posterior gastro-enterostomy	15	
Anterior gastro-enterostomy	2	
Anterior gastro-enterostomy and enterostomy	2	
Total	113	1

Proper pre operative preparation will usually make primary resection possible if it can be done at all. Finally the methods of resection employed show that in 50 per cent it was apparently safer and easier to re-establish continuity by an antecolic end to side anastomosis adding to this in all cases except one an entero anastomosis. The Billroth I operation or its modification is not suitable because in planning a direct approximation of stomach



Fig 3



Fig 4



Fig 5

Fig 3 Hyperthyroidism in child 9 years of age. Mother had hyperthyroidism. Child had pus in urine and was treated for urine infection for 8 months. This was followed by bulging of the eyes and enlargement of the neck. Dyspnea on slight exertion. Pulse 130. Very ill after thyroidectomy.

Fig 4 Hyperthyroidism in child 10 years of age. Child always nervous and irritable. Had slight difficulty in speech. Thyroid enlarged with bruit and thrills. Nervousness, tachycardia, emaciation, exophthalmos developed

9 months after symptoms were first noticed. Interval of 3 months between ligations and between second ligation and lobectomy. Every operative procedure followed by marked reaction.

Fig 5 Hyperthyroidism in child 9 years of age. Soft bilateral enlarged thyroid with thrills. Nervousness, marked tremor, pulse 120. Exophthalmos had been present for 1 year before examination. Bilateral ligation of the superior thyroid artery and thyroidectomy were followed by marked reaction.

in children could be attributed. Chmenko reports a series of cases in one family in which the mother, two daughters and a child of each of the daughters, one a boy and the other a girl, had the disease. The mothers of 8 of our own patients had had goiters, and in at least two instances hyperthyroidism had also been present in the case of one of the mothers who had shown symptoms of hyperthyroidism. The goiter had developed during pregnancy. In 2 of the cases in which the history states that the mother had had a goiter, the fathers had also had goiters, one of them being of the exophthalmic type.

Klein reports 3 cases in which hyperthyroidism followed the removal of tonsils and Wheelon reports the case of a child of  $4\frac{1}{2}$

years in whom exophthalmos with status thymolymphaticus followed varicella and mastoiditis. Prominence of the eyes developed rapidly during the attack of chicken pox and the typical syndrome of hyperthyroidism followed. In only a few of our cases is there any history of a directly antecedent infection. In 1 case the patient when 3 years old had had an attack of whooping cough accompanied by very marked convulsions. Soon after this attack a bilateral exophthalmos with tachycardia developed and these symptoms persisted until the child was brought to us at the age of 7 (Fig 1). In another case a girl of 9 years a bilateral exophthalmos appeared 3 weeks after an attack of scarlet fever. In 2 cases there was a history of tonsillitis in 1 of

## HYPERTHYROIDISM IN CHILDREN

By ROBERT S. DINSMORE, M.D., CLEVELAND, OHIO  
Cleveland Clinic

THE incidence of hyperthyroidism in children as has been pointed out by Hyman is probably higher than would be supposed from the comparatively small number of cases which have been reported in the literature. In all of the 48 cases here reported the patients were under 14 years of age.

Buford in a very exhaustive review of both foreign and American literature found only 8 cases of exophthalmic goiter in children under 5 years of age and only 18 cases in children under 12 years of age in a total series of 1,512 cases. In 1913 Lewis of the Mayo Clinic reported 5 patients all under 10 years of age. In none of these series was there a male patient. In 1933 Cowden who had gone over the literature on this point noted that exophthalmic goiter had not been reported in a male child under 10 years of age. In a series

of 3,477 cases Klein reports only 154 under the age of 15 and in this series the males were above 12 years of age. Bram who has had a very large experience in treating exophthalmic goiter reports a series of 43 patients under the age of 15, his youngest patient being just past her fifth birthday. Barrett reports 1 patient only 2½ years of age. In 1912 White reported a case of congenital Graves disease and Klaus in 1914 reported the presence of hyperthyroidism in an infant of 9 months.

In our series 1 patient was 5½ years old, one 7, although the onset of the disease could be definitely placed at the age of 3. 2 were 8 years of age, 2, 9, 3, 10, 4, 11, 3, 12, 13, 13, and 17, 14 years of age. Among the males 6 were 14 and 2 were 12 years of age.

It has been difficult to find a definite etiological factor to which hyperthyroidism



Fig. 1. Hyperthyroidism in child 7 years of age. At left, patient at age of 2 years before development of hyperthyroidism. At right, appearance of patient on admission to clinic. Father had exophthalmic goiter, mother adenoma of the thyroid. Syndrome of hyperthyroidism followed attack of whooping cough at age of 3 years. Bilateral exophthalmos, smooth cylindrical enlarged thyroid gland, bruit and thrill, pulse 120.



Fig. 2. Hyperthyroidism in child 10 years of age. At left, patient at age of 6 years before development of hyperthyroidism. At right, appearance of patient on admission to clinic. Duration of hyperthyroidism 1 year. Three sisters with goiter; patient extremely nervous, had taken iodine 1 week in each month for 9 months. Was easily fatigued. Parents had noticed prominence of eyes and rapid heart. Bilateral exophthalmos, bilateral enlargement of thyroid with bruit and thrill was present. The heart was enlarged at the left; the pulse rate was 118. Ligation was followed by reactions; thyroidectomy was performed with secondary cure.

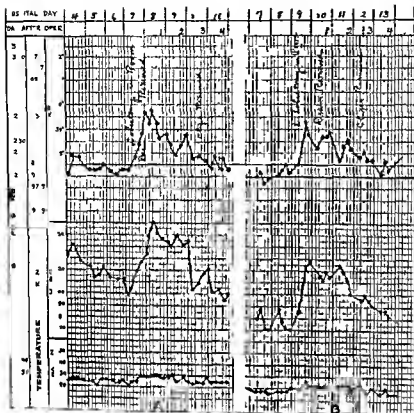


Chart 1

Chart 1 Chart showing reaction following successive lobectomies A (left) First lobectomy B Second lobectomy 5 weeks later

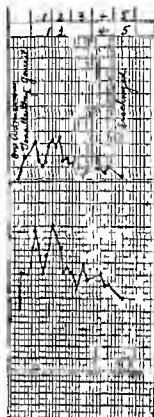


Chart 2

Chart 2 Chart showing severe reaction following total thyroidectomy performed in the presence of hyperthyroidism in child 13 years old

The highest pulse rate observed in our series was 162 the average for these cases being 125

So far as we have been able to note the mentality of these children has been normal for the age an observation which is in accord with that of Klem

A study of recent literature pertaining to the determination of basal metabolism in children shows a considerable divergence of opinion as to what may be considered the normal rate for different pre adolescent and adolescent ages. One of the most recent studies is that of Cameron who has reported an investigation extending over 3 years as the result of which he concludes that the results by Benedict and Talbot on the basis of body weight are too low for the children of Winnipeg. He attributes this difference

to the type of machine used and to the possibility that a climatic factor is involved. Benedict advises that estimations of basal metabolism in children be made on the basis of height rather than weight. Cameron used weight in his estimations of all pre adolescent children. As stated by DuBois it is obvious from the variations in the findings of these observers that "much more work on the subject is needed". In view of the difficulties of controlling children, especially the hyper excitable child with hyperthyroidism and of the present uncertainties as to the best method to employ it is obvious that estimations of the basal metabolism in children should be interpreted on the basis of normal estimations secured by the same observer.

The treatment of hyperthyroidism is the same whether the patients are children or



Fig. 6 Hyperthyroidism in child 13 years of age. Patient has had goiter since birth, no symptoms until 6 months ago, developed nervousness, rapid heart and lost 40 pounds following an attack of grippe, exophthalmos and tremor, bilateral nodular goiter, pulse 100, basal metabolism rate +56 per cent.

which the hyperthyroidism was very definitely increased during an attack. In another case a child of 8 years a visit to the dentist was followed by a nervous breakdown accompanied by nausea and vomiting which necessitated her remaining in bed for 3 days after which a bilateral enlargement of the thyroid developed with bristly thrills and a pulse rate of 134.

The question as to whether iodine may produce an induced hyperthyroidism is raised by its widespread use in the schools for prophylactic purposes. Hyperthyroidism which may be due to this cause does occur but fortunately in a very small percentage of cases. Marine and Kimball report that among 4415 school children who received this treatment hyperthyroidism developed in only  $\frac{1}{2}$  of 1 per cent and that in these cases the condition disappeared promptly when the iodine treatment was discontinued. DeQuervain reports the interesting case of a

child of 9 years who had a small goiter which was unaffected by the weekly administration of 5 milligrams of iodostarine. When the dosage was increased to 1.75 grams of iodine weekly, the goiter diminished in size but symptoms of marked hyperthyroidism appeared—tachycardia, loss of weight and extreme nervousness. When the iodine was discontinued these symptoms disappeared but the goiter again began to increase in size. DeQuervain believes that the risk from iodine in these cases is almost nil if the dose does not exceed 3 milligrams. The effect of large doses of iodine was illustrated also in one of our cases, a girl of 14 years who for four months had received excessive doses of iodine. During this time a marked hyperthyroidism developed which persisted in spite of the discontinuance of the iodine. When we saw her 6 months later the hyperthyroidism was still very marked; she was extremely nervous and had a very rapid pulse.

As has been noted above, in most of the cases in our series there has been no familial history of goiter or thyroid enlargement or of infection, and in most of the cases the illness has lasted for months rather than for years.

Our observations regarding the sequence of symptoms in these cases conform with those of Burnett, namely nervousness followed by enlargement of the thyroid gland with tachycardia and exophthalmos. The nervousness and irritability of the children are usually the characteristics first noticed by the parents. Some writers have contended that exophthalmos in these children is a rare symptom; in a series of 39 cases Barrett reported that exophthalmos was present in only 8. This has not been our experience.

Griffith has pointed out that tremor occurs less frequently in children than in adults, but Klein thinks that tremor usually follows the appearance of the tachycardia and irritability. Tremor was noted in 25 of our 48 cases.

Sixteen of the children in our series showed loss of weight: 1 child of 14 years lost 20 pounds and 2 others both 14 years old each lost 13 pounds. Many of these children, however, show no change in weight so that this is not a constant symptom.

THE CARE OF THE HANDICAPPED GOITER PATIENT<sup>1</sup>

BY ROBERT S. DINSMORE, M.D., CLEVELAND, OHIO

Cleveland Clinic

IN considering methods for the rehabilitation of handicapped goiter patients one should have clearly in mind the groups of cases in which operation is peculiarly hazardous and the fact that whatever the type of case the same general measures for restoration and conservation are in the main effective. The groups of goiter cases in which the hazard of operation is especially marked are: first cases of hyperthyroidism in adults in whom symptoms of the disease are outspoken and of long standing; second, all cases of hyperthyroidism in children; third, cases of adenomata in elderly patients with or without hyperthyroidism; and fourth, cases of large intrathoracic goiter.

The principal conditions which contribute to the risk which attends hyperthyroidism are: (1) marked loss of weight within a short period of time; (2) myocardial changes; (3) dehydration and impending acidosis; and (4) instability of the nervous system. Each of these conditions in itself suggests the method of rehabilitation to be employed. Thus the excessive metabolism which has resulted in the rapid loss of weight demands absolute rest in bed with control of the hyperactive nervous system by sedatives. Dehydration and impending acidosis with the attendant vomiting and diarrhoea are met by the administration of large quantities of fluid which we prefer to give by means of the subcutaneous infusion of normal saline to which novocain has been added as suggested by Bartlett. When delirium develops in a patient with acute hyperthyroidism we are confronted with one of the most difficult problems encountered in this disease. The transfusion of whole blood is a very effective remedy and often results in immediate improvement and we have had instances in which the patient became rational following the transfusion. In some of these cases however a true psychosis may develop if that occurs a guarded prognosis should be made both as regards the risk of operation and the ultimate result. In such cases I feel that a minimum period of 7 months should

elapse before any operative procedure is undertaken.

To protect the myocardium digitalis is given before operation to patients in whom myocardial changes have developed—a measure which was first proposed by Dr. Frank Gibson in 1910. It should be borne in mind that in many cases of hyperthyroidism there has been persistent tachycardia for a long period of time with resultant hypertrophy and dilatation of the heart and that these cases are especially subject to auricular fibrillation. It should be emphasized however that digitalis cannot control tachycardia and that massive doses of digitalis should not be given. Patients who have received preoperative treatment with digitalis have a much smoother postoperative cardiac convalescence and are certainly less apt to develop postoperative auricular fibrillation. While it is quite true that patients may have postoperative auricular fibrillation without any further cardiac embarrassment nevertheless I am always anxious in such cases inasmuch as some of the patients develop a dilatation of the heart. Our routine method is to give 30 minims of the tincture of digitalis every 4 hours for 6 doses so that the patient receives 180 minims during a period of 24 hours.

Lugol's solution has proved to be an extremely important addition to the preparation for operation of patients with true exophthalmic goiter of the hyperplastic type and we are indebted to the Mayo Clinic for having brought this measure to our attention. As a result of its use we have been able to perform thyroidectomies as a primary operation in many cases which otherwise would have required preliminary ligations. There are certain points regarding the use of Lugol's solution however which should be considered. Early in its use it was frequently noted that patients appeared to be in better condition than was actually the case as has been pointed out by Lahey so that it was found to be inadvisable to operate at the time of the



adults excepting that it should be borne in mind always that especial care must be exercised in handling these children as they are very susceptible to every form of stimuli and may be very ill after the operation. While cases of acute hyperthyroidism may occur I believe they are of rare occurrence. In nearly all our cases certainly the condition was chronic and such cases are never cured, I believe unless the gland is removed. Eleven of our cases were not operated upon. These included one case in which hypopituitarism was present and treatment was directed to that condition, 7 in which a period of "watchful waiting" was advised one in which we felt that a preliminary tonsillectomy and adenoidectomy were indicated and 2 cases of induced hyperthyroidism which cleared up when the administration of iodine was discontinued. As these children are all very poor operative risks the same careful handling is required as in severe cases in adults. In nearly every instance it is necessary to ligate the superior thyroid artery first on one side and a few days later on the other side 3 months before the thyroidectomy is performed. The reaction even to the ligation, is often very marked. Chart 1 shows the reaction following a thyroidectomy in a child 8 years old. In the latter case the child was extremely ill for 48 hours but later made an uneventful recovery.

The presence of foci of infection and their removal brings up an important point in the management of these cases. We have found

that invariably the child will obtain greater benefit from the thyroidectomy than for instance from the removal of the tonsils and we have found moreover that a tonsillectomy performed in the presence of severe hyperthyroidism is apt to cause a very severe reaction. This is illustrated by Chart 2. We have therefore concluded that in severe cases the goiter should be removed first the removal of foci of infection being deferred until after the child has recovered from the thyroidectomy.

#### CONCLUSIONS

Hyperthyroidism in children is perhaps more common than has been supposed and reported cases will undoubtedly appear more frequently in the future.

The etiology is unknown. A small percentage of the cases reported in the literature and in our own series followed acute infections but ordinarily there is no tangible factor to which the disease can be attributed. The onset is abrupt and the clinical course rapid. Induced hyperthyroidism may follow the prophylactic use of iodine in a very small percentage of cases but this can usually be controlled by the discontinuance of the iodine.

These children are extremely susceptible to all kinds of operative procedure and must be handled with extreme care.

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they would recur on successive days so that the dose of magnesium sulphate had to be repeated. We now use a parathyroid extract prepared according to the method developed by Professor Collip of the University of Alberta which has proved to be a specific in the treatment of this condition. Only one or two intramuscular injections of 1 cubic centimeter each of the parathyroid extract is sufficient whereas large and repeated doses of magnesium sulphate are required. Moreover we have found that parathyroid extract has been equally effective in the treatment of some cases in which the tetany had persisted for a number of years and strange to say in both

acute and chronic cases there has been no reduction in the calcium content of the blood.

#### CONCLUSION

In conclusion it is my belief that by the employment of absolute rest in bed with sedatives of large quantities of fluid of blood transfusions especially in delirious patients of Lugol's solution of guarded doses of digitalis, of local anæsthesia with light gas oxygen anæsthesia or analgesia of a multiple stage operation performed in the patient's room the handicapped goiter patient has the advantages of manifold measures for his protection.

## THE REHABILITATION OF THE CARDIOVASCULAR PATIENT<sup>1</sup>

By FRANK H. LAHEY, M.D., F.A.C.S. AND BURTON E. HAMILTON, M.D. BOSTON, MASSACHUSETTS

OUR experience with reconstruction of patients with chronic cardiovascular disease has been gained purely from clinical effort to relieve or delay disability of individual patients. We have not adopted any particular therapeutic agent and applied it universally.

Cardiovascular disability of course includes in its great variety of disorders some conditions which require or suggest a specific treatment for example special drug treatment of the patient with auricular fibrillation and rarely other more dramatic measures such as removal of the cervical sympathetic ganglia periarterial sympathectomy embolectomy and resection of the ribs over a grossly enlarged heart.

In the majority of cases however chronic cardiovascular disease is determined by a fixed end result pathology not to be directly approached. Treatment is forced toward removing coincident burdens such as weight reduction of the obese removal of evident foci of infection and adjustment of habits drugs diet hygiene and living conditions. We feel that adequate care of the patients demands an individual treatment based pri-

marily on direct personal diagnosis laboratory diagnosis alone and routine treatment being insufficient.

We realize that our enumeration of these well known therapeutic considerations may appear like platitudes and risk the obvious inadequacy of this introduction to the vast subject of reconstruction of patients with cardiovascular disease in order to avoid the impression that we overvalue the single important new point of view that our experience has brought us that is the removal of coincident surgical burdens.

We wish to stress particularly the operability of these patients. They may be operated upon under certain conditions with surprisingly low mortality.

Of 136 cases with serious rheumatic heart disease personally examined by us and followed through major surgical operations (partial thyroidectomies abdominal section and herniotomy) 6 died. The group includes a majority with mitral stenosis a fair number with aortic regurgitation or both of these lesions 31 with auricular fibrillation and 36 with clear evidence of decompensation. One death only occurred in 87 operative cases of

apparent maximum improvement. In a personal conversation with me Dr Pemberton stated that because of some reactions that had occurred when he had operated during this period of apparent maximum improvement he has made it a rule to delay operation until 4 days after the apparent maximum improvement is noted. This has been our experience also. In our uncomplicated cases the period of maximum improvement after the administration of Lugol's solution has appeared at about the eighth day. The optimum time for the operation therefore is on the twelfth day. In a certain group of patients even after this interval there is a question as to whether or not the lobectomy can safely be performed. These cases emphasize the value of a 'trial ligation'. If no reaction follows the ligation then the lobectomy can safely be performed. Our experience has been also that it is most advantageous to perform the operation after a single course of treatment with Lugol's solution as it may be extremely difficult to reproduce the same status after successive courses of treatment. I wish to call attention to Dr Donald Guthrie's excellent editorial on the use of Lugol's solution which appeared recently in this journal.

The second group of handicapped goiter patients namely children with hyperthyroidism must be handled with especial care. Hyperthyroidism in children is characterized by an abrupt onset and usually a short clinical course. Even after the most careful and painstaking preparation they are apt to react seriously to any operative procedure. Often both the local and the general anesthetic even if the latter is not carried beyond the stage of analgesia have a bad effect on these children. Therefore the operation should be so planned as to require a minimum amount of the anesthetic and the surgeon should be prepared to interrupt the operation at any moment. Excellent results often follow ligation in these cases the improvement often being far more striking than that seen in adult patients. A special word of caution should be offered regarding the danger of performing a tonsillectomy in the presence of hyperthyroidism in children as the reaction may be much more severe even than that which

follows the thyroidectomy. In these cases it should be the routine procedure to perform the thyroidectomy first.

As for the third group of handicapped goiter patients elderly people with adenomata of long standing the precautions and special measures outlined above for the protection of patients with hyperthyroidism are equally applicable to these cases.

As for the fourth group patients with intrathoracic goiter, one point which is of especial importance is concerned with the postoperative care that is danger from the extravasation of blood in the mediastinum. Unless the surgeon is perfectly sure that there is complete haemostasis the cavity should be packed with gauze and a secondary closure made. In this connection it should be added that after any thyroidectomy the control of wound secretion is very important. For myself I prefer to put in a small gauze drain which is removed at the end of 10 or 12 hours never allowing it to remain longer than this period as the charts of these patients show that in some cases at the end of 8 hours the pulse rate begins to increase and the temperature to rise. Both drop however just as soon as the drain is removed since during the first period the gauze absorbs the wound secretion while after that time it becomes in effect a dam.

A general discussion of the various postoperative complications which may occur is not within the scope of this paper but I do wish to mention postoperative tetany. Fortunately this is of infrequent occurrence but it is very distressing when it does occur. The first symptom of the condition may be a circumoral pallor accompanied by slight tingling of the hands and feet and nervousness. These symptoms are usually transient and are limited to two or three attacks. In a small number of these cases however generalized tonic convulsions develop with characteristic contractures of the hands and feet and occasionally with laryngeal stridor. In the treatment of this condition we formerly gave an intramuscular injection of 20 cubic centimeters of a 25 per cent solution of magnesium sulphate. This always produced relaxation but on the other hand when convulsions occurred we could be reasonably certain that

to believe that the severely disabled patient with cardiovascular disease is a good risk in routine surgery. These fragile patients deserve elaborate pre operative care and in spite of the most painstaking preparation, a definite number will die unexpectedly and suddenly. The first essential is accurate diagnosis of the cardiovascular condition. We have routinely used indirect methods of diagnosis: urinalysis, kidney function tests, blood chemistry, cell counts, blood pressure, examination of the eye grounds, and so forth. We believe them, however, to be but adjuncts of clinical diagnosis and do not feel that they should be allowed to be the uncorrelated basis for determining operability of patients. We do not believe that any formula based upon these indirect tests will adequately express operability.

Similarly study of the heart by graphic methods has its direct value as an aid to diagnosis but does not occupy a prominent place in determining operability. Indirect tests for cardiac function with which we have had considerable experience do not appear to be of great value in this connection.

From our experience nothing can supplant direct personal diagnosis and daily supervision in estimation and control of dangerous cardiovascular risks. For example the signs and history of gross congestive heart failure are sometimes confusing, may readily be overlooked, and can only be discovered by careful direct examination and history taking. Operating within 3 weeks of a congestive failure (even though of brief duration) is something to be avoided if possible from our experience. Though we have operated successfully in many cases when signs of congestive failure were still present and on a small number of patients who had chronic failure of the an-ginal type, the time has been chosen only when prolonged medical care showed the

patient to be at his best in terms not only of laboratory tests and of physical signs but general welfare as shown for example by the character of the respiration, sleep, and absence of anxiety. Though we have avoided routine digitalization, proper digitalization of patients with auricular fibrillation and associated rapid ventricular rate can readily be shown to reduce cardiovascular disability. This and rarely other disorders of the heart are sometimes overlooked at routine surgical examinations. Although routine electrocardiographic tracings will determine the diagnosis in most but not all of these disorders, for example pulsus alternans, the condition of the patient who has disorderly heart action only in attacks can be discovered solely by direct and continued observation.

#### SUMMARY

To summarize we wish to direct attention to the occasionally indicated method with which we have succeeded in rehabilitating patients with cardiovascular disease by indirect surgical measures. This consists in the removal of surgical burdens. The order of the greatest degree of accomplishment is removal of the toxic goiter, removal of large pelvic tumors, and removal of troublesome gall bladders.

In view of our low mortality with this type of case, we urge that patients of this group who have coincident and burdensome surgical lesions after proper consideration and preparation by rest and partial or complete restoration of compensation be operated upon and relieved of such lesions. It has been our experience that if there is co operation between cardiologist, anæsthetist, and surgeon, not only will the mortality in this seemingly hopeless group be surprisingly low, but the degree of restored ability in many cardiovascular cases will be strikingly high.

this group with severe rheumatic heart damage but with neither auricular fibrillation nor failure

Of 67 operative cases with hypertension regular heart beat, and enlargement of the heart secondary to the hypertension 1 died. Four had congestive heart failure 2 had persistent alternation of the heart beat 2 had had hemiplegias.

Of 37 cases selected for gross enlargement of the heart or auricular fibrillation or anginal or congestive failure (or combinations of some of these) attributable to cardiovascular sclerosis (obviously very poor cardiac risks) 3 died.

A few cases of clinical cardiovascular lesions have been operated upon without a death.

A small group of 22 cases with probable congenital heart disease furnished 4 operative deaths and some unpleasant surprises.

Of 150 cases with established auricular fibrillation (many of these with otherwise badly damaged hearts and with decompensation) there were 6 operative deaths.

A group of more than 100 patients with gross congestive heart failure and thyroid toxicity have been operated upon with 3 deaths.

In all the cases enumerated the patients clearly had severe cardiovascular disease. No one could wish for them as surgical patients.

Study of the deaths in the whole group shows that those cases with severely damaged hearts such as mitral stenosis or aortic regurgitation but without congestive failure or auricular fibrillation had a negligible mortality (excepting the small group with suspected congenital heart disease). The distinct impression left with us by most of the dangerous cases those with failure auricular fibrillation or both is that they have tolerated operative procedures surprisingly well. Most of this group did not have any actual choice of risk. They were disabled and with little chance for improvement. Removal of the apparently significant surgical burden was the only promising chance for improvement.

We wish to stress also the importance of searching such patients for surgically removable burdens. The patients with both thyroid toxicity and congestive heart failure first called our attention to the possibility of re-

lieving cardiovascular disability in suitable cases by surgical removal of a coincident burden. We have reported this extremely gratifying group. It includes many cases hopelessly disabled in spite of prolonged medical treatment who were returned promptly and safely to full ability by removal of the toxic thyroid. This is a unique group cardiac capacity being restored so strikingly by the removal of a surgical burden.

In an occasional case of rheumatic heart disease without previous disability congestive heart failure has developed in the latter months of a pregnancy. The failure has persisted in spite of medical treatment until well after delivery with unexpected satisfactory return of ability following. These cases have suggested to us also the possibility that some other large coincident mechanical burden surgically removable may in occasional cardiovascular cripples be the determining factor in disability.

Exclusive of the thyroid cases and those with the burden of pregnancy no single large group of such complicating surgical burdens is to be expected among cardiovascular cripples. We have however, a small but steadily growing group of such patients improved of disability by the removal of a coincident diseased gall bladder or a large pelvic tumor.

The operability of patients with severe cardiovascular disease is not generally appreciated nor consequently the possibilities of indirect surgical treatment. Many of our thyrocardiacs have been disabled for long periods while under the care of excellent physicians before the significance of a toxic adenoma or obscure signs of thyroid toxicity was suspected. Along the same lines histories could be given of cases in which a significantly diseased gall bladder or large uterine fibroid was overlooked or wrongly deemed not operable in the face of an obvious cardiovascular handicap. Experience indeed shows that this point of view is often not appreciated by the man whose position makes him apt to be frequently appealed to for final judgment as to surgical risk and advisability of surgery.

We wish finally to stress the need of careful preparation of cardiovascular patients for surgical treatment. We are not fatuous enough

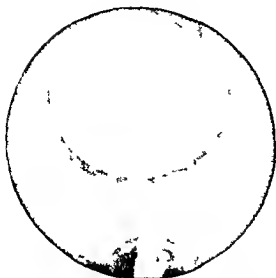


Fig 1. Cystogram of bladder in which prostatic obstruction has been of only short duration. There is no elevation of the base of the bladder and but little irregularity of the bladder outline.



Fig 2. Cystogram of bladder in which prostatic obstruction has been of several months duration. Note the irregularity in the bladder outline and multiple cellules the result of long continued intravesical pressure.

tected on physical examination. Such cases are best treated by removing only the obstructing portion of the gland. This can be most efficiently done by means of the punch operation through the urethra as the recent improvements in instruments makes possible the removal of much larger amounts of tissue than in the past. Recently we have used this operation in fully a third of our cases of prostatic hypertrophy and Caulk reports that he uses it in as high as two thirds of his cases.

*Care and treatment of associated infection.* Pylonephritis is the most common form of infection complicating the preparatory treatment for prostatectomy. Usually of urethral origin it is carried from the prostatic urethra

The third cause of symptoms out of proportion to the physical findings is prostatic infection. Infection by increasing the size of the gland allows the accumulation of sufficient residual urine to increase the infection still further and so a vicious circle arises. In infected cases removal of the obstructing portion of the gland by means of a punch operation permits of complete emptying of the bladder and thus the infection is rapidly reduced. The performance of a radical operation often so activates the infection that the seminal vesicles and surrounding structures become extensively involved in a very acute process which of course produces symptoms of dysuria and frequency as marked as those from which the patient sought relief.



Fig 3. Cystogram of bladder in which obstruction has been of long duration. Cone shaped deformity of dome characteristic of urethral obstruction of long duration easily mistaken for diverticula.



PREPARATION OF PATIENTS FOR PROSTATECTOMY<sup>1</sup>

By HERMON C. BUMPUS Jr M.D. ROCHESTER MINNESOTA

Sect. u. l. g. May Clinic

**I**N the care and preparation of patients with prostatic hypertrophy for operation there are four main points to consider (1) the duration and amount of the obstruction (2) the indications for and against cystoscopy (3) the care and treatment of associated infection and (4) the restoration of impaired renal function to a point compatible with major surgical measures.

*Duration and amount of obstruction.* The duration of the obstruction is of course largely determined by the history but evidence obtainable from cystograms is more reliable. If the obstruction has existed for only a short time there is slight if any deformity of the bladder (Fig 1). If it is of longer duration, the outline becomes trabeculated and irregular and is characterized by multiple cellules where the mucosa has projected through the muscle fibers (Fig 2). When the obstruction is of extreme duration the bladder tends to become cone shaped and irregular in outline and is usually associated with one or more diverticula (Fig 3). The recognition of the presence of diverticula is important for if they do not empty freeing the urine from infection becomes impossible and when large their surgical removal considerably increases the operative risk. To make certain of the presence and position of diverticula cystograms should be taken in triplicate. Two plates exposed with the shadow of the bladder projected from either side will usually show the shadow of the diverticula well beyond the bladder outline. The third cystogram taken after emptying the bladder shows diverticula that do not drain. In the interpretation of such cystograms care must be taken not to confuse the shadow of the elongated dome of the bladder as it projects beyond the shadow of the body of the bladder with that of a possible diverticulum. The error is not difficult to make.

The extent of the obstruction is ascertained by the amount of residual urine present. If

it is less than 120 cubic centimeters intermittent catheterization for a minimal period of 10 days is usually sufficient preparation provided renal function is adequate. If the amount of residual urine is more than 120 cubic centimeters the introduction of a permanent urethral catheter is preferable. This reduces manipulation to a minimum insures continuous emptying of the bladder and thus prepares it for the condition which will exist after operation.

*Indications for and against cystoscopy.* In cases of prostatic hypertrophy cystoscopy should be avoided if possible. The passage of any rigid instrument is bound to traumatize the urethra in such cases. A roentgenogram reveals the presence of stones or diverticula, and rectal examination reveals fairly accurately the size of the gland so that little additional knowledge would be obtained by cystoscopy. Only in those cases in which the symptoms are out of proportion to the prostatic enlargement is cystoscopy indicated. Such a discrepancy is usually due to one of three causes.

One cause is paralysis of the bladder musculature the result of a lesion of the spinal cord in which case cystoscopic examination in the absence of prostatic enlargement reveals trabeculation and atony of the bladder usually associated with relaxation of the urethral sphincter. Occasionally such nerve lesions occur in conjunction with benign hypertrophy when the prognosis as to functional result following prostatectomy should be most guarded since atonic bladders are slow to heal and suprapubic sinuses irritatingly persistent while the amount of residual urine may increase rather than diminish as a result of the further injury to the nerves incident to the operation.

A second cause of discrepancy between physical findings and symptoms is confinement of the hypertrophy to the median lobe. If the prostatic enlargement extends into the bladder rather than the rectum it is not de-

TABLE I—BEDSIDE RECORD SHOWING THE GRADUAL REDUCTION OF BLOOD UREA BY THE DAILY INTRAVENOUS ADMINISTRATION OF PHYSIOLOGICAL SODIUM CHLORIDE SOLUTION TWENTY FIVE CONSECUTIVE INJECTIONS WERE MADE INTO THE SAME VEIN

[illegible]

diminishes as a result of overflow the receptacle is lowered. Usually from 3 to 4 days are sufficient for complete emptying. After the bladder is emptied the elimination of the retained toxic substances throughout the body is accomplished by the giving of large amounts

of fluid and their elimination by sweating, purgation, and diuresis. A careful record must be kept of the fluid intake and output, a minimal output of 2 500 cubic centimeters being imperative. If this cannot be maintained by the oral administration of fluids,

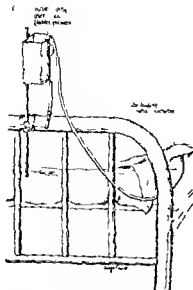


Fig 4 A simple method of gradually emptying the bladder against a constant pressure

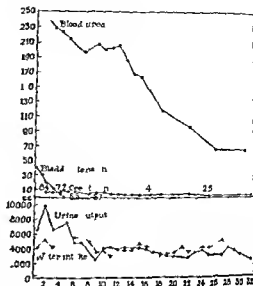


Fig 5 Chart showing the daily reduction of bladder tension with a corresponding fall in blood urea and creatinine as a result of forced fluid intake which was more than 4,000 cubic centimeters daily

through the blood stream to the renal parenchyma where in fatal cases multiple small abscesses are discernible at necropsy. During the initial symptoms consisting of a sudden rise of temperature and chills colon bacilli can occasionally be cultivated from the blood stream as pointed out by Cribot. Usually its course is self limited lasting from 4 to 7 days with decreasing rises in temperature. Numerous drugs including mercurochrome, methylene blue, acriflavin and hexamethylenamine have been employed in its treatment but with the exception of hexamethylenamine none has proved generally efficient. The administration of the latter is more satisfactory when given intravenously than orally as doses sufficiently large to produce results will not upset gastric digestion. Mercurochrome given intravenously occasionally yields striking results. The febrile reaction subsides immediately in some cases but in others it is extremely toxic and has even proved fatal so that its routine use is impossible.

**Restoration of impaired renal function.** The restoration of the impaired renal function sufficient to permit of major operations is naturally the most important aspect of the

preparation of patients with prostatic hypertrophy many of whom endure urinary obstruction until the renal function as determined by the phenolsulphonephthalein test has reached the vanishing point and the urea content of the blood has reached over 300 milligrams for each 100 cubic centimeters. The establishment of adequate drainage is first undertaken. If the obstruction is complete and acute retention is present great care must be exercised to empty the bladder gradually. To remove a few ounces at a time is dangerous as this immediately reduces intravesical tension and so produces edema of the entire urinary tract. Such edema within the renal capsule results in diminished output of urine and the patient is made worse rather than better. Several methods for the continuous gradual emptying of the bladder are in use, the simplest and I believe the most satisfactory being the one described by Van Zwaluwenburg (Fig 4). By this method the urethral catheter is attached to a long tube filled with fluid and empties into an elevated receptacle at the foot of the bed. The height of this receptacle is determined by the pressure within the bladder and as this gradually

TREATMENT OF THE SURGICAL PATIENT HANDICAPPED  
BY URINARY OBSTRUCTION<sup>1</sup>BY VERNE C HUNT MD FACS ROCHESTER MINNESOTA  
D I on of S rgy M y Clinic

**B**ELFIELD, in 1890 reported a series of 133 cases from this country and abroad in which the prostate had been radically removed. He compared mortality rate and ultimate functional results in the suprapubic and perineal methods of removal. Forty one of the operations were by the perineal method with a mortality rate of 9.7 per cent, 88 were by the suprapubic method with a mortality rate of 13.6 per cent. 4 were by the combined method. Restoration of voluntary urination was equally satisfactory following either method but occurred in only 71 per cent of the cases. The relatively high incidence of failure of the radical operation to restore voluntary urination may be explained on the basis of incomplete removal of all obstructing portions of the gland in many instances only the median lobe was removed. Lowsley's embryological studies correlated with Wilson's and McGrath's work on the pathology of benign prostatic hypertrophy are supported by clinical experience in showing that prostatic hypertrophy is not confined to the median lobe but occurs at least as often in the lateral lobes with or without involvement of the median lobe. Removal of the lateral lobes when hypertrophied ensures the elimination of all obstructing prostatic tissue and with the improvement of surgical procedures good ultimate functional results have increased following both the perineal and suprapubic methods of prostatectomy. That unmistakable progress has been made in the perfection of both methods is attested to by the total restoration of voluntary urination after either method as conducted for benign hypertrophy today. While the perineal operation was accompanied by a lower mortality rate in the earlier years of prostatic surgery improvement in the suprapubic method has apparently eliminated this difference.

Numerous arguments have been presented since Belfield's original report setting forth

the advantages and disadvantages of the perineal and suprapubic methods. However an unprejudiced analysis of the ultimate functional results and mortality rate following both methods of operation by those experienced in them shows that these indexes of merit can no longer be utilized to discredit one or the other method.

Deaver has shown that the average mortality rate from prostatectomy performed by the occasional or inexperienced operator in this field of surgery is between 20 and 30 per cent. Such a high mortality rate seemed to justify the investigation of the causes of death an analysis of the factors influencing lethal effect and the presentation of means of prevention.

In the early years of prostatic surgery little was known of the effects of prostatic obstruction no methods had been devised for measuring those effects and no therapeutic means were available for obviating them. However investigation has resulted in reliable tests of renal function and experience has taught their application so that more or less standardized methods have been devised for the more successful management of the patient with prostatic obstruction. Experience has also taught that adequate management embraces more than surgical removal of the gland. As Bugbee has said Removal of the prostate gland is but an incident in the treatment of prostatic obstruction.

Since prostatic obstruction occurs most commonly between the ages of 60 and 75 years far beyond the average age for surgical conditions the patient must be considered a substandard risk not only because of his age, but because of the coincident cardiovascular changes and the renal insufficiency incident to urinary retention. Recognition of these conditions has led to methods of preparation for prostatectomy to enhance the patient's physical and organic reserve which lessen the

subcutaneous or intravenous administration must be supplemented preferably the latter, for repeated subpectoral infusions are most trying to the patient and their frequent administration results in costal pain that is most distressing. It has therefore been my practice to give 1000 cubic centimeters of physiologic sodium chloride solution daily intravenously until the desired results relative to urinary output are attained. If care is exercised the same vein may be employed repeatedly, as many as 25 times in succession, from 20 minutes to half an hour usually being required in the administration. Under this form of treatment the amount of urinary infection usually diminishes rapidly (Fig 5).

Following the administration of fluid the patient is put daily in a hot pack and a profuse sweat induced. No method has proved as free from danger of burns and overheating as the large electric blanket. The patient can be completely wrapped in this and the current turned off as soon as sweating is initiated. Five or 10 grains of aspirin given just prior to the pack or in refractory cases pilocarpine, is a useful adjunct. Under this form of treatment the urea content of the blood usually diminishes in direct proportion to the duration of the prostatic obstruction (Fig 6). If it has been of long duration 10 milligrams a day is the average amount of reduction. If of acute onset from 50 to 100 milligrams is not unusual. When the urea content of the

blood has decreased to approximately 100 milligrams for each 100 cubic centimeters the advisability of an ultimate one or two-stage operation may be considered.

If the patient tolerates a urethral catheter well the preparation may continue with this form of drainage until the urea content of the blood is below 40 milligrams for each 100 cubic centimeters. If the decrease has been slow and the patient's general condition poor with considerable loss of weight and strength, it is safer to perform a cystostomy and permit him to return home for a few weeks or months as under home environment and food he gains far more rapidly than in the hospital once adequate drainage has been established. The two stage operation has the advantage of insuring considerable diminution in the size of the prostate since after the urethra is put at rest, the decrease in edema and engorgement reduces the size of the gland also the amount of bleeding at the time of operation is much less. However, it compels a blind enucleation, a poor surgical procedure bound to be followed by a certain number of inferior functional results.

To undertake cystostomy before the urea content of the blood is below 100 milligrams for each 100 cubic centimeters is to diminish materially the possibility of the patient's recovery as so reduced a renal function will frequently not bear the added load imposed by the operation.

Careful physical and roentgenographic examination of the lungs may disclose chronic pulmonary lesions notably chronic bronchitis bronchiectasis emphysema, and so forth which predispose to acute postoperative exacerbation and pulmonary complications

In the evolution of suprapubic prostatectomy it was a common observation that patients who had survived simple cystostomy for retention or for removal of vesical calculi and had recovered from the depression subsequently underwent radical removal of the prostate gland with a relatively low mortality rate. This gave impetus to the two stage prostatectomy which is yet indispensable when there are associated vesical lesions severe cystitis marked renal insufficiency senility intolerance to the urethral catheter and trauma of the urethra. Prostatectomy simultaneous with removal of large vesical calculi and excision of large diverticula in the presence of marked cystitis is accompanied by a higher mortality rate than the two stage operation. In my experience less than 6 per cent of patients are intolerant to drainage by the permanent indwelling catheter and require cystostomy. The two stage operation is necessary in certain cases to ensure the minimal risk, but that it deserves adoption as a routine is questionable. Excellent drainage of the bladder is facilitated through permanent urethral catheterization in most instances and limits the surgical procedure to one operation which permits exposure visualized conduct of the operation and accurate hemostasis so necessary to the best functional results and avoidance of surgical accidents. Employment of the method of gradual decompression as described by Van Zwaluwenburg has often obviated the necessity for preliminary cystostomy.

That drainage of the bladder is the most important factor in preliminary treatment does not necessarily mean that cystostomy should be performed as attested to by the favorable results of the indwelling urethral catheter. Between January 1913 and January 1915 suprapubic prostatectomy was performed in 1783 cases at the Mayo Clinic. In only 43, (4.6 per cent) was preliminary cystostomy necessary. While the average mortal-

ity rate following prostatectomy at the Mayo Clinic for the twelve year period was 5.5 per cent the mortality rate for the two stage operation was 7.5 per cent as compared to 4.8 per cent for the one stage operation. The mortality rate following the one stage operation was lower than the two stage by virtue of the better general condition of the patients selected for this method and the mortality rate following the two stage operation would have been lower than it was had the latter been employed as a routine in all cases. However as approximately 75 per cent of patients when carefully selected may be satisfactorily prepared and operated on by the one stage method with relative safety the diluent effect on mortality rate is an insufficient reason for employing the two stage operation as a routine. Whatever the various opinions regarding the one and two stage procedures drainage of the bladder by urethral catheter or cystostomy permits recovery from renal insufficiency with stabilization of renal function and decreases the stress on the cardiovascular system and respiratory apparatus.

#### EFFECT OF PRELIMINARY DRAINAGE

Between January 1913 and January 1925 there were 113 deaths following suprapubic prostatectomy at the Mayo Clinic. Fourteen occurred from 30 days to as late as 6 months after operation but these resulted from conditions existing prior to operation or from intercurrent conditions to which the operation bore no relation. These cannot be considered as surgical deaths. However 99 of the deaths occurred within 30 days after operation and even though it would seem that in some instances the operation was but an incident and had little to do with the death these are all classified as surgical deaths. Thirty three of the patients who died had been prepared by suprapubic cystostomy and obviously comprised the group of patients who on account of associated vesical lesions marked renal insufficiency and poor general condition were the poorest surgical risks. 22 were prepared by permanent or intermittent urethral catheter drainage and as a group comprised patients who were considered as fair surgical risks. 44 had small amounts of residual urine and no

risk of the operation and reduce the mortality rate. Willius has recently shown that 42 per cent of patients with prostatic obstruction have cardiovascular disease and that the incidence of cardiovascular disease is higher with prostatic obstruction than with many other diseases during similar decades indicating that co existing cardiovascular disease is increased by persistent urinary retention.

The causes of death following prostatectomy may be classified in three groups (1) pre existing and co existing organic disease (2) surgical accidents and (3) postoperative complications. Group 1 comprises renal insufficiency, cardiovascular disease, chronic pulmonary disease and diabetes. The most common causes in Group 2 are hemorrhage, shock and anæsthetics. Group 3 includes pulmonary complications, general sepsis, embolism, and peritonitis. Experience has shown that many of these causes of death are preventable. In the early years of prostatic surgery many patients were operated on immediately. Urinary retention due to prostatic enlargement was regarded and treated as an emergency and too often prostatectomy was performed without preliminary examination to determine the physical and organic reserve of the patient. Acute urinary retention may at times not be amenable to other than surgical drainage but prostatectomy is never an emergency procedure. In most instances the careful passage of a urethral catheter is successful and allows sufficient time to ascertain the physical status of the patient and to determine by what means and at what time permanent relief of the obstruction may be considered. In obstructing lesions of the large intestine with resultant toxæmia, removal of the lesion is of secondary importance to the relief of the obstruction. Likewise in cases of prostatic obstruction it is primarily important to relieve the obstruction. Eradication of the prostate should be considered only after the patient's recovery from the effects of obstruction with stabilization of his physical and organic reserve.

As co existing renal insufficiency, cardiovascular disease and chronic pulmonary lesions are directly responsible for 50 per cent of deaths following prostatectomy and in

directly responsible for many others due to postoperative complications, their treatment preliminary to operation is essential. Since urinary retention with resultant renal insufficiency and subsequent uræmia in cases of long duration directly affect renal function and secondarily enhance co existing cardiovascular and chronic pulmonary disease, drainage of the bladder forms the keystone of treatment preliminary to prostatectomy.

#### PREPARATORY TREATMENT

Determination of the time at which prostatectomy may be undertaken with safety depends on the amount of rehabilitation possible in the individual case as indicated by various tests. The phenolsulphonephthalein test of Rowntree and Geraghty and the urea content of the blood are accurate indexes of renal function and relatively easy of conduct and interpretation. The salivary urea estimation according to Hench and Aldrich has simplified the determination of urea retention and affords accurate measurement of renal insufficiency with the simplest of laboratory equipment. Estimation of renal function determines the amount of renal damage incident to retention acts as a guide to the time at which operation may be considered with safety and serves as a relative prognosis for recovery and post operative life. These tests of renal function require repetition at frequent intervals during the period of pre-operative treatment to permit accurate interpretation of the effects of treatment. Except under most unusual circumstances preliminary treatment should be continued until the reactions to the renal functional tests have become stabilized within or near normal limits. It is only through the employment of these tests that the time may be accurately determined at which operation may be carried out with the minimal risk.

Electrocardiographic studies in conjunction with clinical investigation of the cardiovascular system has become routine in the determination of the status of the patient with surgical prostatic obstruction. The electrocardiogram makes the diagnosis of cardiovascular changes approach an exact science, facilitates estimation of the cardiovascular reserve and serves in making a relative prognosis.

## PHYSIOLOGICAL PRINCIPLES IN THE TREATMENT OF BENIGN HYPERTROPHY OF THE PROSTATE<sup>1</sup>

By WALTER M. WALTERS, M.D., ROCHESTER, MINNESOTA  
Sect. in Surg. of the Mayo Clin.

**I**NCOMPLETE obstruction whether in the stomach intestine common bile duct or urinary tract produces a toxæmia with the accumulation of non protein nitrogen such as urea in the blood due to an increase in the breakdown of the body proteins or to its retention in the blood stream resulting from the failure of abnormally functioning kidneys to eliminate it. With the toxæmia and accumulation of urea in the blood the acid alkali balance may be disturbed with resulting acidosis or alkalosis. These chemical changes in the blood caused by the obstruction unless recognized and compensated for may cause the death of the patient. Although the relief of the obstruction whether it is biliary intestinal or urinary is essential to ultimate recovery it should not be undertaken until the condition of the patient affords a reasonable assurance that an operation may be safely performed.

### METHODS OF RESTORATION

The preparation of such patients for operation demands the correction of the function of the kidneys liver and intestinal tract and the control of infection. The neutralization detoxication and elimination of the toxic products resulting from the obstruction are essential. The necessity for maintaining a normal fluid balance in the body is apparent in every type of disease water in sufficient amounts drunk by the patient allows an interchange of fluids between the body tissues and the blood. It is a solvent and diuretic and is of great value in the elimination of nitrogenous material such as urea and creatinin. The concentration of water in the blood stream affects the regulation of body temperature as shown by Barbour. A diminution of the fluid content of the blood causes a decrease in the oxygen carrying power of the red blood cells by reason of increased viscosity.

The intravenous injection of a 1 per cent sodium chloride solution which has been used by Bumpus in the preparation of patients with benign hypertrophy of the prostate who are handicapped by disturbance of renal function not only supplies the blood and tissues with fluid but increases the number of chloride molecules which may have a detoxicating effect as evidenced by the satisfactory control of toxæmia in other types of obstruction and stasis.

The condition of the patient is dependent not so much on what passes from the body by way of the kidney the intestine and the skin as on what remains in the blood and in the tissues. Whereas many years ago the constituents of the excretory products were looked to for an indication of the functional capacity of an excretory organ we now look to the blood and determine accurately what is being retained in the body.

Sodium chloride solution injected intravenously usually suffices to control the toxæmia co existing with prostatic obstruction. It is sometimes advantageous to add glucose since it is quickly oxidized in the body to produce heat and energy. This can be done by the continuous intravenous drip suggested by Matas or by means of repeated injections of a 10 per cent glucose and 1 per cent sodium chloride solution which has been found by McVicar adequately to control the toxæmia resulting from gastro intestinal stasis. Opie and Alford have shown experimentally that when sufficient carbohydrate is supplied to animals the effects of chloroform and phosphorus poisoning on the liver cell are considerably lessened. In the case of toxic products of protein disintegration glucose besides protecting the cell, probably forms glyconates with them in which form they are excreted. It is a reasonable hypothesis that the beneficial effect derived from the intravenous injection of glucose is partly



demonstrable renal insufficiency, and were considered good surgical risks without preparation

A review of the clinical course and necropsy findings obtained in 85 per cent indicates that 50 per cent of the deaths were due to pre-existing and co-existing disease that is cardiovascular renal disease and pulmonary lesions 4 per cent were due to surgical accidents, that is hemorrhage and shock 46 per cent were due to postoperative complications such as pulmonary complications general sepsis embolism, and peritonitis Seventy five per cent of the deaths occurring in that group of patients considered the best surgical risks by virtue of small amounts of residual urine no demonstrable renal insufficiency and so forth and the operation of prostatectomy undertaken without preliminary treatment were due to the causes enumerated under Group 1 Thirteen deaths from postoperative complications were due to pulmonary embolism 11 patients dying from this cause had been considered excellent surgical risks and were operated on without preliminary treatment That the occurrence of pulmonary embolism bears a distinct relationship to lack of preliminary treatment is beyond question

In the group of 437 patients (24.5 per cent) who had had preliminary cystostomy the mortality rate was 7.5 per cent for the subsequent prostatectomy 666 (37.3 per cent) received no preparation and the mortality rate was 6.6 per cent 680 (38 per cent) had been prepared by urethral catheter drainage and the surgical mortality rate was 3.7 per cent In other words the mortality rate following prostatectomy on the best surgical risks with out preparation approaches closely that of the

exceedingly poor risks requiring cystostomy and is twice that following preparation of patients by urethral catheter drainage

The necessity for preparation in all cases is apparent and successful management demands drainage of the bladder preliminary to prostatectomy for at least 10 days often for longer periods This has recently been accomplished by permanent urethral catheter, followed by the one stage visualized suprapubic prostatectomy in 80 per cent of the cases

The adoption of this principle of management in all cases has resulted in the removal of the prostate gland in 204 cases at the Mayo Clinic during the present year with but 3 deaths in 172 consecutive cases of which the one stage operation was employed with but 1 death

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in which the operation was performed for one reason or another by the perineal route

#### APPROACH TO THE PROSTATE

In a discussion of any operative procedure it should be borne in mind that when more than one procedure can be used for the treatment of a surgical condition the one chosen should be that which can be followed with the greatest degree of safety to the patient and which carries the least risk of unpleasant postoperative complications and sequelae.

In general there are indications for both the suprapubic and the perineal methods of approaching the hypertrophied prostate depending on the condition of the patient and the specific pathologic condition of the urinary tract. When routine preliminary preparation of all patients with urinary obstruction is carried out prior to operation and the patient's condition enables him to withstand operation the risk of prostatectomy is approximately the same whether the gland is removed through a suprapubic or a perineal incision. The suprapubic transvesical approach has the advantage that it permits the removal of co-existent lesions of the urinary tract such as vesical stones and diverticula or even tumors of the bladder. While this is impossible in a one stage perineal operation exploration and drainage of the bladder preliminary to perineal prostatectomy as carried out by Lowsley overcomes this disadvantage. It has been the experience at the clinic in most cases that the presence of vesical stones or diverticula contra-indicates a one stage operation since they are usually associated with infection of the urinary tract which combined with the additional operative procedure increases the risk of prostatectomy. In some instances however diverticula may exist with but little cystitis and the absence of infection and of foul urine in the diverticulum may permit by means of a suprapubic approach to the prostate the safe excision of the diverticulum at the same time as the prostate is removed. On the other hand Hugbee has obtained his best results by performing suprapubic prostatectomy in two stages as a routine treating

associated lesions of the bladder and providing drainage at the first operation and later when the condition of the patient permits, enucleating the gland after enlarging the suprapubic drainage sinus sufficiently to permit the introduction of the finger into the bladder.

Without preliminary preparation including control of urinary infection and in the absence of studies of renal function to determine the capacity of the kidneys the risk of a one stage operation may be lower when the prostate is removed through a perineal incision on account of the dependent drainage and because the perivesical tissues have not been opened to infection. When the prostate is small and considerable prostatitis is present the perineal operation can be expected to give good results. This applies particularly when the obstruction is a result of compression of the prostatic portion of the urethra by adenomata of the lateral lobes. Previous operations on the bladder may cause it to contract to the extent that the perineal approach to the hypertrophied gland becomes preferable. Postoperative ventral hernia complicating such previous operations may indicate a perineal operation which can be thus performed without fear of opening the peritoneal cavity. Recently it was necessary to perform perineal prostatectomy in a case in which a large postoperative ventral hernia had developed following three previous operations on the bladder elsewhere for the removal of vesical stones.

Should the perineal approach be chosen the technique of Young has become classic as a model. Davis has devised a haemostatic bag to be used after perineal prostatectomy and this has proved as satisfactory in the control of immediate haemorrhage following perineal prostatectomy as the Hagner-Pilcher bag in the suprapubic operation. Still considerable experience is required for perineal prostatectomy if uniformly good results as measured by urinary control and healing without fistula are to be expected. Occasionally even after skillfully performed perineal prostatectomy these unpleasant sequelae occur and may necessitate secondary operations.

the consequence of this detoxication of the products of abnormal protein catabolism. Glucose too acts as a diuretic and its value in the treatment of toxæmia resulting from biliary retention has been described by Judd and Burden.

Should acute retention of urine in the bladder occur the necessity for withdrawing the urine gradually is apparent since its sudden removal may be sufficient to cause suppression of urine. The relation between the circulatory pressure and urinary pressure may be disturbed by alteration of either. The renal blood pressure may be reflexly affected by vasomotor influences from the rapidly relieved bladder the urinary pressure in the tubules may be suddenly altered with release of the excessive pressure in the bladder. If the alteration in the relative pressures on the two sides of the secreting renal cell is sudden enough and profound enough suppression will result. In addition, the change of the relative pressures on the two sides of the secreting cell is likely to inhibit the function of the cell. The same principle applies in the relief of biliary obstruction. Crile has shown the advantages of slowly relieving the pressure in an obstructed biliary tract by allowing only a gradual escape of bile through the drainage tube. In biliary obstruction resulting from a malignant neoplasm at the head of the pancreas anastomosis of the gall bladder and the intestine which permits only a gradual release of the obstruction achieves results far superior to those obtained by external drainage such as cholecystostomy in which the pressure is quickly and suddenly relieved.

With the gradual relief of the obstruction whether spontaneous or induced improvement in the patient's general condition is at once apparent. Coincidentally antibodies apparently appear which increase the resistance of the patient. It is a fact that operations performed on debilitated patients in whom improvement has begun are attended with as little risk as though complications had not appeared. The appearance of the patient and his opinion as to the condition of his health usually indicate when improvement begins. Also the phenolsulphonaphthalein

test of Rowntree and Geraghty and an estimation of the amount of urea in the blood give accurate information concerning the functional capacity of the kidneys. Should the condition of the patient be such as to increase the risk of surgical procedure then the usual methods of restoration suffice in most instances to prepare the patient for a safe operation.

In order that there may be the smallest possible residue of nitrogen the diet should consist for the most part of carbohydrates with a minimum of protein and fat. Although 60 per cent of protein can be metabolized by the body into glucose the process leaves a residue of nitrogenous by-products which may accumulate in the tissues and in the blood and place additional strain on kidneys the function of which is already unbalanced as a result of obstruction and infection in the urinary tract.

Cabot has said that infection does not develop in a previously clean bladder following catheterization until overdistention from urinary obstruction occurs. With prostatic obstruction the patient is usually unable to empty the bladder entirely and the resultant accumulation of residual urine forms an excellent culture medium for bacteria. For this reason it is essential during the preparation of patients with hypertrophy of the prostate in the presence of urinary infection to see that the bladder is kept entirely empty either by means of an indwelling urethral catheter which can be satisfactorily used in 75 per cent of cases as shown by Hunt and Bumpus, or by means of suprapubic cystostomy.

The pre-operative treatment of patients with benign hypertrophy of the prostate has materially assisted in the reduction of the mortality rate of prostatectomy. In 204 consecutive operations for prostatectomy performed between January 1 and October 1, 1925 by Hunt and myself there were three deaths, one of which occurred from facial erysipelas on the thirtieth day following the prostatectomy from causes entirely remote from the operation. For the most part, prostatectomy was suprapubic with the exception of approximately 10 per cent of my own cases.

in which the operation was performed for one reason or another by the perineal route

#### APPROACH TO THE PROSTATE

In a discussion of any operative procedure, it should be borne in mind that when more than one procedure can be used for the treatment of a surgical condition the one chosen should be that which can be followed with the greatest degree of safety to the patient and which carries the least risk of unpleasant postoperative complications and sequelæ.

In general there are indications for both the suprapubic and the perineal methods of approaching the hypertrophied prostate depending on the condition of the patient and the specific pathologic condition of the urinary tract. When routine preliminary preparation of all patients with urinary obstruction is carried out prior to operation and the patient's condition enables him to withstand operation the risk of prostatectomy is approximately the same whether the gland is removed through a suprapubic or a perineal incision. The suprapubic transvesical approach has the advantage that it permits the removal of co-existent lesions of the urinary tract such as vesical stones and diverticula or even tumors of the bladder. While this is impossible in a one stage perineal operation exploration and drainage of the bladder preliminary to perineal prostatectomy as carried out by Lowsley overcomes this disadvantage. It has been the experience at the clinic in most cases that the presence of vesical stones or diverticula contra-indicates a one stage operation since they are usually associated with infection of the urinary tract which combined with the additional operative procedure increases the risk of prostatectomy. In some instances however diverticula may exist with but little cystitis and the absence of infection and of foul urine in the diverticulum may permit by means of a suprapubic approach to the prostate the safe excision of the diverticulum at the same time as the prostate is removed. On the other hand Bugbee has obtained his best results by performing suprapubic prostatectomy in two stages as a routine treating

associated lesions of the bladder and providing drainage at the first operation and later, when the condition of the patient permits enucleating the gland after enlarging the suprapubic drainage sinus sufficiently to permit the introduction of the finger into the bladder.

Without preliminary preparation including control of urinary infection and in the absence of studies of renal function to determine the capacity of the kidneys the risk of a one stage operation may be lower when the prostate is removed through a perineal incision on account of the dependent drainage and because the perivesical tissues have not been opened to infection. When the prostate is small and considerable prostatitis is present the perineal operation can be expected to give good results. This applies particularly when the obstruction is a result of compression of the prostatic portion of the urethra by adenomata of the lateral lobes. Previous operations on the bladder may cause it to contract to the extent that the perineal approach to the hypertrophied gland becomes preferable. Postoperative ventral hernia complicating such previous operations may indicate a perineal operation which can be thus performed without fear of opening the peritoneal cavity. Recently it was necessary to perform perineal prostatectomy in a case in which a large postoperative ventral hernia had developed following three previous operations on the bladder elsewhere for the removal of vesical stones.

Should the perineal approach be chosen the technique of Young has become classic as a model. Davis has devised a hæmostatic bag to be used after perineal prostatectomy and this has proved as satisfactory in the control of immediate hæmorrhage following perineal prostatectomy as the Hagner-Pilcher bag in the suprapubic operation. Still considerable experience is required for perineal prostatectomy if uniformly good results as measured by urinary control and healing without fistula are to be expected. Occasionally even after skillfully performed perineal prostatectomy these unpleasant sequelæ occur and may necessitate secondary operations.

The determination of the patient's condition prior to operation and the restoration of patients handicapped as a result of obstruction of the urinary tract have assisted greatly in reducing the mortality rate of prostatectomy. Whether the operation is to be performed in one or two stages suprapubically or perineally, is dependent on the general condition of the patient, the pathological condition of the urinary tract and the experience of the surgeon for what is in the hands of

one is a safe operative procedure with little possibility of postoperative complications in the hands of another becomes an operation of necessity rather than of choice.

In general, after preliminary preparation for operation if the condition of the patient is such as to permit safe prostatectomy it makes little difference from the standpoint of mortality rate, whether the gland is removed through a suprapubic or a perineal incision.

## THE USE OF INSULIN IN SURGERY AND OBSTETRICS

BY F. N. G. STARR, CHIEF MEDICAL OFFICER, AND A. G. HITCHER, M.B. (TOR.) TORONTO, CANADA

THE service rendered to the handicapped surgical patient by the work of that great Canadian, Frederic Banting, can never be measured in words, nor can the gratitude of the diabetic ever be sufficiently expressed.

The diabetic patient is remarkably liable to the development of complications, many of which require surgical treatment. In the past he has been considered a bad surgical risk. As a result of the disordered metabolism the tissues do not heal readily and at the same time lend themselves more easily to infection. Operative procedure and the anæsthetic both aggravate the diabetic state and may convert a mild case into one of coma. With adequate preoperative and postoperative treatment carried out under insulin administration these dangers can to a large extent be avoided. It is perhaps still true that from a statistical standpoint the diabetic is a poor surgical risk. A large group of diabetics are well on in years and besides this they show premature degenerative changes, especially arteriosclerosis and myocardial disease. Exclude this type of case and it may be said that under careful control diabetes does not materially increase operative mortality.

In the preparation of the diabetic patient for operation various disturbances of metabolism are to be considered: hyperglycæmia, dehydration, ketosis, acidosis, undernutri-

tion and depletion of the carbohydrate stores. Any of these disturbances may be present to a degree which if not relieved may seriously endanger the patient preparing for operation.

The importance of a normal blood sugar level is now generally recognized. It is desirable to allow several days when possible for the determination of the severity of the diabetes and the required amount of insulin to maintain a normal blood sugar level while the patient is on a suitable diet. In emergency operations however this preparation cannot be carried out but in such cases maximum amounts of insulin should be administered during the time that may be available before operation for the purpose of reducing the blood sugar level. In this way the liability to postoperative complications will be much reduced and this is especially true with surgical infections such as the diabetic carbuncle in which reduction of blood sugar will lessen the danger of postoperative pyæmia or multiple abscess.

If there has been much glycosuria it is likely that dehydration has taken place. This becomes early manifest in the increasing thirst of the patient and later by the dry tongue and skin and finally by the soft eye. It is to be remembered that such a patient may have lost more than 5 per cent of his body weight and that 3 or 4 liters of fluid may well be given for 2 or 3 days when well marked signs of dehydration are present.

Traces of acetone in the urine as shown by a weakly positive sodium nitroprusside test may be neglected but any well developed ketone intoxication should be actively treated by increased carbohydrate and insulin administration. Severe degrees of ketosis are unusual unless the case is one of infection when the insulin requirement may be as much as 50 units every 4 hours and glucose given in amounts necessary to control hypoglycemia. As a rule acidosis will clear up with the ketosis under insulin treatment. When marked however alkali may be given but when this is done the amount of alkali given should be determined and controlled by the carbon dioxide combining power of the blood serum.

The nutrition of the patient and the diet require special consideration. Not only is it inadvisable to attempt desugarization by a course of undernutrition but under insulin administration it is possible to prescribe any diet which may be considered necessary to strengthen the debilitated patient. This is especially the case in preparing for operation patients with chronic cardiovascular disease. In uncomplicated cases it is usual to supply a diet containing  $\frac{2}{3}$  to 1 gram of protein per kilogram of body weight and sufficient fat and carbohydrate to provide calories 30 per cent above the basal caloric requirement. Carbohydrate should not be restricted too closely. It is the most readily available form of energy and besides this excess carbohydrate appears to be of value in protecting the liver during the course of the anesthetic and operation. Thirty grams of carbohydrate may be given over and above the usual amount calculated to prevent ketosis. Milder diabetics will tolerate this maintenance diet readily. Many cases however will require insulin which should be administered in amounts adequate to lower the blood sugar level within the normal range. Twenty to 40 grams of glucose or other carbohydrate and 15 units of insulin should be given 2 or 3 hours before the operation.

Postoperative treatment should be carried out to anticipate the disturbances in metabolism as they develop. It is probable that any degree of operative interference aggra-

vates the diabetic state and further damage to the islets of Langerhans may result. Small doses of insulin such as 10 units 3 times a day may be given as a matter of routine as soon as food is taken. This dosage, however, should be based upon the determination of urinary sugar and when possible that of the blood. In major operations some degree of hyperglycemia is unavoidable but insulin should be increased in an attempt to control the rising blood sugar level. When the patient is able to take food a suitable diet is provided by milk and cream and, when tolerated, eggs, fish, fowl, meat, vegetables and fruits gradually added to a maintenance level. Fluids should be provided freely.

After operation ketosis may develop very rapidly and means must be taken to reestablish adequate carbohydrate utilization. When there is hyperglycemia and glycosuria increased doses of insulin may be sufficient for this purpose. Otherwise additional carbohydrate must be supplied. Postoperative nausea and vomiting may occur aggravated by the ketone intoxication and marked dehydration may set in. It may be necessary therefore to administer the glucose and fluid intravenously giving 500 cubic centimeters of 5 per cent solution as often as may be required. In the event of infection or severe toxemia the insulin value may be markedly lowered and the patient may require even as much as 50 units or more 4 times a day. Under such conditions the insulin administration must be pushed until its effect is observed in the lowering of the blood sugar level and the control of the ketone intoxication.

What has been said about the diabetic surgical risk applies with equal force to the pregnant diabetic. The use of insulin has been advocated in the pernicious vomiting of pregnancy. This however does not seem to be necessary for according to a recent study by Harding and Van Wyck now in press the ketonuria is the result of dehydration. They come to this conclusion. Its use in skilful hands may be harmless but we do not believe it to be a valuable adjuvant to treatment and the successful treatment of hyperemesis gravidarum depends upon the use of fluids.

## THE PREVENTION OF DISEASE

A TRIBUTE TO DR MURPHY<sup>1</sup>

BY SIR W ARBUTHNOT LANE Bt MS FRCS LONDON ENGLAND

INTRODUCTION BY RUDOLPH MATAI MD LL.D

Frcdts 1th America College 1S rees

**A**VAILING myself of the agreeable privileges that are accorded me by my official position I am happy to extend a hearty welcome in behalf of the College to the eminent representative of British surgery whose name and fame are known wherever the language of surgery is spoken Sir Arbuthnot Lane

Sir Arbuthnot has come from overseas to deliver the Murphy Oration and to join us in annual tribute to the memory of one of our illustrious founders whom the world justly recognizes as one of the most brilliant exponents of American surgery Apart from his mission and his message the presence of Sir Arbuthnot in our midst is a signal for an enthusiastic manifestation of pleasure and approval Sir Arbuthnot's frequent visits to this country his long known and tried friendship for Americans and American institutions and his generous and unflinching hospitality and kindness to all American surgeons who have flocked to his clinics at Guy's Hospital London suffice at all times to assure him of a cordial reception

To those of us who have enjoyed the privilege of seeing him at work in his operating theater at Guy's it would be superfluous to speak in his praise Those who have not been so fortunate know his merit in their own work for it is through his original teachings and example that one of the most fruitful advances in modern surgery has been accomplished

Many years ago when the study and teaching of human anatomy was my chief preoccupation I learned to admire him through his published writings as a master of that fundamental branch of surgical knowledge in which the British school has excelled and still remains as a model and an unchanged inheritance in our class rooms Later when I came in contact

with him I was not surprised to find a surgeon whose courage and daring were only surpassed by his originality resourcefulness and skill In one day I saw him do a difficult palatoplasty for cleft palate a resection of the lower jaw an open reduction and plating of both bones of the forearm for fracture and a resection of the colon for what is now known as Lane's disease upon all of which he stamped the seal of his personality by the originality of his methods and the smoothness ease and perfection of technique that proclaimed him a great master—a master who dared where others quailed and who succeeded where others would have failed without his skill his precision and the discipline and method with which he planned his operations

Sir Arbuthnot Lane is one of those rare surgeons who knows no limit to the anatomical territory in which he can exercise his art He is as much at home in the extremities as in the head and trunk in the bones and joints as in extirpating a colon in doing an ileosigmoidostomy as in ligating and excising an internal jugular to stop an otitic infection on its fatal way to the lungs

In this extraordinary versatility we recognize a close analogy to the creative and technical genius of Murphy In both the mind in conception of ideas and the hand with the cunning of the craft are united in harmony to attain great objectives to open new and untrodden paths In both the craft of the artisan is inspired and guided by the imagination of the artist

Murphy invented that marvel of mechanical ingenuity the Murphy button which gave a new impetus to intestinal and abdominal surgery But more than this he later conceived a new pathology of septic peritonitis and by his original methods of treatment robbed this most formidable of surgical complications

of half its terrors. By his original method of direct end to end anastomosis of divided arteries he laid the foundation for the modern conservative treatment of wounded blood vessels. He gave a new hope to the victims of pulmonary tuberculosis by adding artificial pneumothorax to our therapeutic resources. He illumined our knowledge of nerve repair and injury. Last but not least he revolutionized and systematized the principles and practice of joint surgery thus laying the foundation for the rehabilitation of numberless cripples by his method of modern arthroplasty.

Lane gave us a metallic plate and the mechanical implements which modified in many ways have been instrumental in transforming the old methods of bone setting into a finished osteoplastic art. He gave a new outlook on the treatment of fractures and created a veritable renaissance in the history of the traumatology of the skeleton. He taught us new methods by which to overcome many hitherto insuperable difficulties in the cure of cleft palate. He taught us how to save lives that would otherwise have been lost from the migration of acute ear infections by the timely ligation and excision of the jugular vein. He taught us the secrets of a new technique based upon a mastery of anatomical detail which made the extirpation of the entire colon a feasible and legitimate operation. He gave us a new view of the mechanism and effects of chronic intestinal stasis and in doing this he pointed to hitherto undescribed anatomical anomalies and pathological membranes which retarded the faecal circulation now familiar to us as

Lane's links but more than this he created a new clinical picture of chronic intestinal toxæmia which is now known as Lane's disease.

Both Murphy and Lane enlarged our vision, by expanding the surgical horizon and leading us to new surgical possessions which we are now industriously cultivating with profit and with promise of still greater benefits. The broad concepts and innovations initiated by both have gone through many vicissitudes and modifications since the time when they were first given to the profession but whatever the future may have in store for their ultimate destiny in theory and practice the names of Murphy and Lane will remain permanently inscribed in history as men who made surgery better than they had found it.

How fortunate and fitting that this hour which we have reverently consecrated to the memory of an illustrious founder who gave luster and world renown to American surgery should be graced by the presence and praise of one who shared with him, in an allied sphere the glory of the pathfinder and the pioneer! It is a tribute of one master to another master. It is the voice that proclaims the solidarity of our guild its unity of purpose its aspirations and endeavors its labors and its sacrifices its rejoicings and its rewards in promoting the welfare of mankind.

And this is the soul of surgery and the spirit which animates this College which we see embodied in John Benjamin Murphy and in the person of our honored friend and guest Sir Arhuthnot Lane.

#### THE JOHN B. MURPHY ORATION IN SURGERY

YOU have done me a very great honor in asking me to deliver the Murphy Oration. I need hardly say that I am very proud and pleased to do it and that I heartily appreciate the compliment the invitation carries with it. I have paid you so many visits and have all ways been received in such a very cordial and friendly manner that I am almost tempted to regard myself as one of yourselves. Certainly I am intensely in sympathy with the magnificent efforts you are making to advance our profession from every point of view.

Like you all I loved that great big hearted generous man who was so full of enthusiasm and energy. Though seriously handicapped by feeble health he never allowed anything to interfere with the work in which he took so much pride and interest so that he maternally shortened his life.

I was very fortunate in making Dr. Murphy's acquaintance many years ago as I had obtained one of his buttons and had used it successfully 6 months before any one else in England. The case was published in the *Lancet*



early in 1894. Learning of this Dr Murphy, accompanied by his beautiful wife called to congratulate me on the result I had obtained by the use of his most ingenious and useful device. How many lives that button has saved and how much it has stimulated surgeons to improve their technique is well known to us all. It proved to be one of the greatest advances in abdominal surgery. There are still conditions in which no other method can approach the Murphy button in usefulness. Up to that time the name of Murphy was practically unknown on our side of the water. Our friendship dated from that visit and I have always regarded it as a very great privilege to have since had many opportunities of discussing surgical problems with one with whom I was entirely in sympathy. He was always so ready to take an active interest in any new problem on which his fertile and imaginative brain invariably cast some fresh light. He was essentially an original man as well as being a superb teacher. I know as do so many of his intimate friends how much Murphy owed to the constant care and devotion of his charming belpmate who seemed to possess the secret of perennial youth. While unable to control his indomitable will in the pursuit of science she did her utmost to provide him with the care and attention necessary to enable him to continue his arduous occupation. Not only did she look after his health but she took a very active share and interest in his surgical work. Although many years have elapsed I can vividly remember her description of the manner in which the button was evolved and the anxiety and interest with which they both watched the result of its use in animals before employing it in the human subject. Her love and care played no small part in making Murphy's career the great success it was.

What struck me most in Murphy was his wonderful generosity a quality which is so largely shared by other great American surgeons. He was always most anxious to accord praise to others wherever it was possible and often avoided claiming for himself much original investigative work.

The excellence of his surgical work appealed to every one as did also his remarkable breadth of vision and his foresight.

He possessed in a peculiar degree a power to hold and hypnotize his audience beyond that of any other surgeon I have met. He appeared to take possession of his hearers and to imbue them with a feeling that whatever he said was true.

Few of us will forget his operations and his demonstrations in his theater. Geniuses of the type of Murphy are not teachers in the ordinary sense in that they do not produce the like among their immediate entourage but on the other hand they exert an immense and wide spread influence on the whole community. That was essentially the case with Murphy.

I spent much time with him in that memorable conference in 1914 of which he was the distinguished president and when we had many conversations about chronic intestinal stasis in which he took a very active interest and for which he foretold a great future. At that time not only did few people accept my views on this subject but the bitterness of the attacks of many members of our profession was characteristic of their usual attitude toward any ideas with which they were not familiar. Murphy was infinitely more practical. He saw a large number of my cases both before and after operation. He was present at many operations and he investigated the histories of these patients in his usual thorough manner. He was one of those who accepted my views and gave me his hearty encouragement for which I was most appreciative and grateful. I am also glad to remember that he took precisely the same attitude when the operative treatment of simple fracture was being opposed in the usual acrimonious manner.

I trust that you will not think me egotistical if I read to you a portion of Dr Murphy's last letter to me which I need not say gave me very great pleasure. It is characteristic of him.

My dear Colleague I have still greater feeling of gratitude to you for your contributions to the Congress in so many ways. Your indefatigable zeal in your clinics made you the ideal busy surgeon of the world. You cannot comprehend how much you have endeared yourself to the American medical profession by your work during the Congress. The doctors are returning now and every day I hear comments on your work. Surely your ears must often burn as they are so sincere in their praise of you. I feel that in doing this work you were paying a personal

compliment to me as president as well as to the surgical profession of America. Your colleagues certainly did themselves proud and all who had the opportunity of attending the Congress say that it is the best meeting we have ever had from an educational standpoint.

I feel that I cannot do better than to discuss with you that subject which was nearest his heart when I last saw him since I am certain that he would have asked me to do so if he were alive and with us here.

I am very glad to do it since I realize that intestinal stasis is the dominant factor in medicine being the basis of all morbid conditions peculiar to a state of civilization and that the greatest duty that devolves on the members of our profession is by obviating its development to prevent disease to safeguard the community from the misery ill-health and loss of earning capacity it entails and to raise the physical standard of the people to the highest possible level. If we can succeed in doing this our general happiness and well being will be enormously increased and the maximum enjoyment of life secured.

It is not that I wish to depreciate the skill and ability of surgeons and physicians who do their utmost to deal with the symptoms and end results of chronic intestinal stasis but I am convinced that it is only by following the course indicated namely by prevention that stasis and its end results will cease to exist and the necessity for building an increasing number of hospitals and asylums will disappear simultaneously.

Such was the idea that permeated Murphy's brain and one which I am proud to share with him in endeavoring to carry out in this oration devoted to his great memory such views on the prevention of disease as I believe would be acceptable to him if he were present with us.

In order to be able to obviate the incidence of disease it is absolutely necessary that in the first instance we shall clearly understand the factors upon which its development depends. Here nature affords us endless experimental evidence and supplies us with definite data on which we can base our arguments and formulate our views.

There are still existing large native races who are living under normal conditions in

their natural surroundings and are eating precisely the same food they have eaten for many hundreds or thousands of years. They have continued the same habits without any variation.

We can also trace these people through the varying degrees of civilization to which they have been exposed owing to their coming in contact with the white man eating his food and imitating his habits. We observe that while living their normal life in natural surroundings they lead a very happy existence in the full enjoyment of all the pleasures of life. Their very smile suggests a cheerful disposition and a happy outlook on life generally.

They may not infrequently have circulating through the several tissues of their bodies a great variety of organisms usually in the form of minute worms.

In the vast majority of cases they suffer very little if any inconvenience from their presence since they do not interfere materially with their activity or with the satisfaction of their appetites. Occasionally as in the case of yellow fever cholera plague dysentery etc the virulent organisms which are the causes of these diseases may prove fatal very rapidly. While the mortality resulting from these infections is great we must remember that they will be eliminated sooner or later by sanitary methods. These natives suffer from none of the diseases of the gastro intestinal tract nor from the consequences of such affections as abound in civilized communities, which are exacting a rapidly increasing toll from the lives health happiness and general vigor and physique of the race.

The general physique of these natives is magnificent while all their functions are performed normally and efficiently so that they live healthy vigorous happy lives. The negroes afford us excellent experimental evidence of the effect which varying degrees of civilization have upon them for the reason that they migrate from their normal surroundings and acquire the food and habits of those with whom they become domiciled and whom they are proud to imitate unfortunately to their serious detriment.

As you trace them up through Central America, through the Southern States and finally

up to Chicago you find that while they have been freed from the infective conditions to which they were exposed in their native surroundings they have steadily acquired the diseases of the gastro intestinal tract and the conditions consequent upon them in a degree directly proportional to the state of civilization in which they exist. When the conditions and circumstances in which they live become identical with those of the white man the incidence of the diseases of civilization is exactly the same in the negro as it is with us.

Can anything be clearer than the evidence afforded by this experiment which can be repeated over and over again in the various portions of the globe?

Let us consider what are the differences in the food and habits which have produced such a disastrous change in the health of the native.

In normal conditions the native baby depends entirely on the mother for its food since there are no artificial substitutes available. The period of lactation is very prolonged so much so that the child discards the breast only when he begins to take the normal food of its parents.

In civilization the cessation of the napkin stage is followed by an enforced state of constipation for at least 24 hours since it is considered by white races that a single action a day is sufficient for health.

The native on the other hand continues the habit of emptying the colon after each meal throughout the whole of his subsequent career consequently the intestines act naturally in response to the normal stimulus and for that reason undergo no abnormal change in their structure during the individual's lifetime.

In civilization the enforced accumulation of at least 24 hours' contents in the terminal segment of the large bowel results in a tendency to its progressive elongation and distention. Because of the inconvenience such a result would produce nature endeavors to control and prevent this elongation and dilatation by fixing the bowel by acquired bands or membranes which at first secure and shorten the mesentery and later grip the bowel fastening it immovably to the floor of the iliac fossa and rotating it on its longitudinal axis. By this the lumen of the bowel is obstructed

and material is dammed back in the proximal segments of the colon. The portion of the bowel which is anchored ceases to function normally and becomes inflamed so that the passage of the intestinal contents through it is progressively impaired. If the patient is fat hernial protrusions or diverticula may form in the bowel proximal to the obstruction a condition the causation of which I described in 1883. Finally the chronically inflamed and irritated segments not infrequently develop cancer.

A quarter of a century has elapsed since I described the mode of development of this acquired obstruction the first and last link, and called the attention of the profession to what I believe to be by far the most important evolutionary structure in the human body which has ever been observed and one that is productive of the most disastrous consequences. It is a regular Pandora's box.

I was led to the discovery and appreciation of the importance of this new development by a study of the changes which the body undergoes when its mechanical relationship to its surroundings is altered from the normal.

I found that the human anatomy bears a simple mechanical relationship to its surroundings and varies definitely and rapidly with any change in that relationship. This I demonstrated in the clearest manner possible in the dissecting room of Guy's Hospital by the examination of the dead bodies of laborers who had been engaged during their lifetime in various arduous occupations. A careful investigation of the changes which their structure underwent in consequence of the special functions performed proved to be so characteristic so definite and so precise that from an examination of the anatomy of these workers one was able to determine with absolute accuracy the labor history of the individual or in other words the functions he performed habitually during his lifetime.

The laws which I have formulated as governing these changes are quite simple and can be readily understood by a study of these labor conditions. They are

1 The skeleton represents the crystallization of lines of force.

2 Pressure produces definite changes

Fig 1 Fracture of lower end of humerus<sup>1</sup>

Fig 2 Fracture of lower end of humerus

## 3 Strain produces definite changes

4 When apart from the exercise of pressure or strain it is important from the altered mechanical relationship to man's surroundings that an old mechanism should be modified or an entirely new one developed such a change takes place. The modifications in the structure of the body which arise in obedience to these laws ensue in order to meet the altered mechanical relation of the individual to his surroundings and to economize the expenditure of nerve and muscle energy.

The principles which govern the mechanical relationship of the organism to the gastrointestinal tract which is inside the body differ in no particular from those that influence its behavior in its mechanical relationship to surrounding objects. *Precisely* the same laws apply in both instances.

The consequences which result from the habitual overloading of the end of the large bowel with at least 24 hours accumulated contents a condition which is practically universal in our state of civilization and is recognized as being normal are met on the part of the organism by an attempt to control the excessive dilatation distention and elongation of the portion of the intestine which is affected by that accumulation. The effort to establish this control is usually more or less successful. The degree of success attained varies

with the vitality of the individual. The attempt to control these changes results in the formation of acquired firm strong bands or membranes simulating peritoneum in appearance which are practically crystallizations of lines of force. They develop along the lines of strain on the under surface of the mesentery of the iliac colon and gradually secure contract and shorten it. Finally they grip the bowel itself rotate it on its longitudinal axis and fasten it to the floor of the iliac fossa. The alteration in the functioning of this portion of the intestine which is caused by the formation of these bands and by the mechanical effect they exert upon the mobility of the intestine leads to a corresponding degree of interference with the passage of material through the anchored and obstructed bowel. In civilization the consistency of the contents of this portion of the large bowel is almost always firm and may often be quite hard a condition which increases still further the resistance which the fecal matter undergoes in its passage through the anchored and obstructed iliac colon. In respect of this factor I need hardly recall to your mind that cancer of the large intestine is eight times more common in the left half of the abdomen than it is on the right side.

I would remind you of another law which I formulated namely that *all the changes that ensue in the body in consequence of the endeavor*



Fig. 3 Fracture of lower end of humerus

on the part of the organism to establish a mechanical relationship to abnormal surroundings of first service of useful purpose but later tend to shorten the life of the individual. In no instance is this law so true and so clearly illustrated as it is in the case of what I call the first and last kink. The effect upon the entire gastro-intestinal tract is in the first instance simply mechanical and is analogous to that which would result in every house in a town from a block in its main sewer. Later it results in the contamination by septic organisms of the nutrient material dammed back and stagnating in the small intestine and stomach and in the terrible sequence of the innumerable morbid sequelæ which ensue in consequence of these mechanical and toxic conditions. When I first called attention to this kink and its consequences the less observant and more conserva-



Fig. 4 Fracture of lower end of humerus

tive portion of the profession denied their existence and some isolated members with that want of courtesy which is so often associated with a corresponding lack of comprehension boldly asserted that the kinks were not present in the patient's body but existed only in my brain.

The more intelligent section of the medical profession looked for and investigated the several kinks I described and finding them began debating their origin. Some believed that they were produced by inflammation since they could not conceive of an acquired band or adhesion arising in any other way. Others considered that they were congenital. Many observers while recognizing them were of the opinion that they did not exert any control over the passage of the contents through the anchored bowel. The simple manner in which they come about was not realized for the obvious reason that the very definite changes which the body undergoes when its mechanical relationship to its surroundings is altered from the normal received little or no attention from a profession accustomed to deal only with the end results of stasis which constitute surgery and medicine.



Fig. 5 Fracture of lower end of humerus

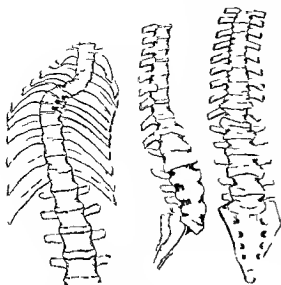


Fig. 6 (left) Spine and ribs of a breeder drayman  
 Figs. 7 and 8 Spine of coal heaver



Fig. 9 Fourth and fifth lumbar vertebrae and sacrum of coal heaver  
 Fig. 10 Fifth lumbar vertebra and sacrum of deal porter  
 Fig. 11 Fourth and fifth lumbar vertebrae and sacrum of laborer who carried loads in front of him

While in a considerable proportion of cases the body has sufficient vitality to form these bands and to effect an obstruction limited to this area in a number of feeble subjects because of a want of formative capacity either no bands are developed or they are not sufficiently strong and rigid to secure the colon which escapes from their controlling influence. In consequence the pelvic colon becomes progressively elongated and distended. The pudling in the pelvis of this elongated and dilated distal portion of the colon produces a degree of obstruction to the passage of solid contents through it which is increased by straining in the effort to expel the motion. It is important to realize that the obstruction so produced is often much greater than that which results from the limited and localized obstruction brought about by the acquired bands forming the first and last kink. The consequences of this type of obstruction in feeble subjects differ from those produced by the kink in that throughout the length of the proximal intestinal tract little or no effort is made to control the elongation and distention of the colon, small intestine and stomach. Consequently, ulceration and cancer of the large bowel, duodenum and stomach so common in association with the first and last kink, which are due to a definite local con-

striction occur very rarely. It is to this condition that the term *enteroptosis* has been applied and many surgeons have endeavored to benefit their patients by performing such futile operative procedures as sewing up the several dilated and elongated segments of the proximal bowel apparently not realizing the causation of the condition. On the other hand in this type which may for convenience be called the atonic variety the infection of the food supply which is accumulated in much greater quantity in the elongated dilated bowel and the consequent intestinal auto-intoxication together with the changes resulting from it form a very much more marked feature. All the mechanical changes I have described have been confirmed radiologically by Dr. Jordan who has studied the subject very closely for many years. They have also been fully verified in every detail by Dr. Nathan Mutch by his accurate thorough and complete investigations in the postmortem room of bodies of patients who died of cancer in the wards of Guy's Hospital.

I need hardly remind you of the disastrous sequelæ which result from obstruction of the colon whether by the formation of bands or by an excessive elongation of its terminal segment. Briefly, they are inflammation of the mucous membrane of the tract, ulceration first simply septic and often later cancerous of the several areas which are subjected to constant impact or strain, infection



Fig. 12

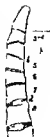


Fig. 13



Fig. 14

Figs. 12 and 13 Spine of laborer who carried load on his head

Fig. 14 Lumbar vertebrae and sacrum of coal trimmer

of the intestinal contents the contamination of the food supply of the body the flooding of the circulation with organisms toxins and other poisonous bodies and the consequent deterioration of the cells of every tissue in the body rendering them liable to the invasion of organisms and to the production of innumerable diseases

Perhaps the term that best describes chronic intestinal stasis is that applied to it by Lauchet. He calls it *the great disease since it is the cause of nearly all the pathology of civilization*. Its manifestations commence in early childhood and end only in death.

It would occupy your time unnecessarily if I were to attempt to describe in detail the enormous mass of disability physical deterioration and disease which is the direct result of chronic intestinal stasis and the many infections which can find a foothold in the human body only because of the depreciation of the vitality of the tissues by auto-intoxication. Indeed it is not an exaggeration to say that we suffer and die through the defects which arise in our drainage scheme.



Fig. 15 (left) Fourth lumbar vertebra of coal trimmer  
Fig. 16 Seventh cervical and first dorsal vertebrae of coal trimmer

The treatment of chronic intestinal stasis varies with the stage at which it has arrived and with the nature of the complications consequent upon it.

In the vast majority of cases the obstruction which results from the presence of a first and last kink or from an excessively elongated pelvic colon can be met effectually by the use of that excellent lubricant paraffin which has done more to improve the health of the people to alleviate suffering and to prevent disease than any other known substance.

The auto-intoxication which arises because of the infection of the stagnating contents of the small intestine can be controlled by the use of kaolin.

By avoiding the use of all meat and fowl which are liable to decompose in the infected contents the infection of the blood stream by toxins etc. is reduced still further.

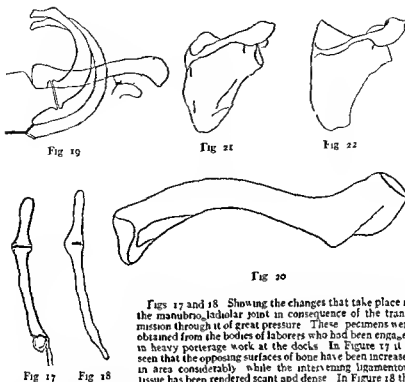
The inflammation of the mucous membrane of the intestine which is so often present and which increases the already existing obstruction by producing spasms of the muscular coat can be very materially benefited by bella donna.

In the advanced stages of stasis the careful freeing and division of the bands which form the first and last kink and the accurate covering of any raw surface by peritoneum restore to the affected bowel and to its mesentery its normal anatomy and function.

Colectomy is called for only in the most advanced cases which are not infrequently complicated with rheumatoid tuberculous or other infection.

Any secondary infection or complication should be sought for and if found thoroughly treated.

Nothing can be more satisfactory than the treatment of chronic intestinal stasis either



Figs 17 and 18 Showing the changes that take place in the manubrioclavicular joint in consequence of the transmission through it of great pressure. These specimens were obtained from the bodies of laborers who had been engaged in heavy portage work at the docks. In Figure 17 it is seen that the opposing surfaces of bone have been increased in area considerably while the intervening ligamentous tissue has been rendered scant and dense. In Figure 18 the joint has been almost completely obliterated by being bridged over in front and by the formation of masses of bone in the ligament posteriorly.

Fig 19 Representing the left first and second costal arches with the manubrium clavicle and coracoid process of a laborer. The manubrioclavicular joint is amphiarthrodial in character while the joint that has developed in the ossified first costal cartilage is freely arthrodial. The position of the costoclavicular articulation is indicated by the dotted outline on the first arch. On the upper surface of the coracoid process the facet which articulates with the clavicle forming the coracoclavicular joint is similarly indicated.

Fig 20 Representing the under surface of the clavicle with the articular facets which correspond with those on the costal arch and coracoid process.

Fig 21 Scapula of shoemaker

Fig 22 Scapula of deal porter

simple or complicated by careful attention to diet and habit while in suitable cases operative interference affords results which would seem to be little short of marvellous.

As the result of observations which have now extended over many years I am exceedingly impressed by what I believe is the invariable sequence of cancer and intestinal stasis. In my opinion there are two factors in the causation of cancer as we see it in civilization namely the mechanical and the toxic.

It is not till these factors have produced sufficient degenerative change in the tissues of the body that they become a soil or medium

in which the cancer organism can grow. This organism cannot grow in a healthy organ.

I have observed cancer imposed on the mechanical and toxic results of chronic intestinal stasis so invariably that I am convinced that the sequence I have described is true in every particular.

I have been equally impressed by the absence not only of cancer but of all the other direct and indirect results of stasis as we see them in civilization in such communities as do not suffer from chronic intestinal stasis.

Our only hope of preventing cancer is by obviating the development of chronic intes-





Fig. 23 (left) Lower end of right humerus of coal trimmer

Fig. 24 Upper end of right radius of coal trimmer

tinal stasis and all its manifestations and results. Cancer is only one of the consequences of stasis but it is infinitely the most incurable and fatal.

The prevention of cancer can be brought about only by a complete revolution in our diet and habits. We must eat such food as will obtain for us the same results that exist in primitive man and we must discard such diet as is deprived of the important components of natural foods. The public must be educated in the knowledge of food and must be impressed by its extreme importance to health.

I am certain that they will be keenly interested in the subject when they learn the explanation of the very simple causes which bring about so much illness, misery and death and recognize the far reaching result of those causes. We must employ every means in our power to distribute information broadcast in the community by literary efforts by propaganda in the newspapers, etc. We will



Fig. 25 Right elbow joint of coal trimmer

thus ensure that a new people will grow up and replace the miserable specimens of humanity which form quite a considerable proportion of the inhabitants of civilized countries especially in the large towns.

Now I come to the important suggestion to which I wish to call your most urgent attention and to ask for all the help you can give in the matter.

It must be perfectly obvious that it is much more desirable and easy to endeavor to prevent the occurrence of cancer than to attempt to deal with it surgically when the condition is established since we are all familiar with the fact that when first detected it is so frequently already inradicable. With that end in view



Fig. 26

Fig. 27

Fig. 28

Fig. 26 Atlas of shoemaker

Fig. 27 Axis and the laryngeal vertebra of shoemaker

Fig. 28 Occipital bone of shoemaker



Fig. 29 Photograph of the bones removed from the right thumb of a shoemaker

we have established a new society in Great Britain with the object of endeavoring to carry into effect the several principles enunciated in this address. It is called The New Health Society. It is supported by a large number of the most distinguished lay scientific and medical people in Great Britain who are intensely interested in promoting the health, happiness and well being of the people and in the elimination of the ill health and disease which they believe are avoidable.

What I would ask you to do is to make a similar society in America and to call it The New Health Society, dedicated to the memory of the great man whose name and fame we are now gathered together to honor and revere. In that way the name of Murphy whose whole life was devoted so unselfishly to helping his fellow creatures will live forever and will stand for all that is great and good in humanity.

In future let the subject of the Murphy Oration be The Prevention of Disease.

Could any man wish for a grander monument or a nobler epitaph!

#### COMMENTS ON ILLUSTRATIONS

The illustrations in this article form excellent examples of the results of the specialization of function to laborers and afford indisputable evidence of the truth of the laws which I have formulated.

In order to obtain a thorough insight into chronic intestinalitis it is necessary to become thoroughly familiar with the manner in which the skeleton and soft parts react when the mechanical relationship of the individual to his surroundings differs from the normal.

Figures 2, 3, 4, and 5 show the manner in which after a fracture of the humerus with displacement of fragments the shaft of the humerus is restored by a process of crystallization along the lines of force; the portion of the old shaft outside the area of the lines of force being completely absorbed.

Figure 6 is the normal spine and portion of the ribs of a brewer's drayman. It represents the attitude which the man assumed on a single occasion fixed and exaggerated. His function was to carry a barrel of beer on his right hip.

Figures 7 and 8 show the changes which the spine of the coal heaver undergoes in consequence of his very laborious occupation. The bodies of the vertebrae are altered in form and their margins have been united to one another by bony ligaments of dense, bony-like bone.

Figure 9 represents the sacrum of the laborer in section. Note the destruction of the fibrocartilage, the forward displacement of the last vertebra producing the condition commonly called pondil listhesis, the division of the arch of the fifth lumbar vertebra into three separate parts and the varying development of the bodies and spinous processes of the lumbar and sacral vertebrae.

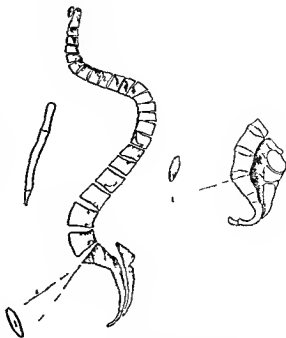


Fig. 29 (left) Spinal column of old woman

Fig. 30 Lower part of spine of feeble old subject

Figure 10 shows the somewhat similar changes which take place in the lumbosacral joint of a coal porter, the synovial joint of the coal heaver being replaced by a typical arthrodial articulation. This results from the laborer having to lift logs from the ground and to deposit them there. Contrast these variations with those present in a laborer whose occupation entailed his carrying loads in front of his trunk as in Figure 11.

Figure 12 shows some of the changes that develop in a man who carries loads upon his head. Figure 13 shows the upper part of the spine in section. Figures 14, 15, and 16 show portions of the spinal column of a coal trimmer. Figure 15 shows the manner in which the fourth lumbar vertebra has been divided in the very forcible rotation of the trunk which occurs in this occupation. Figure 15 shows the divided vertebra in position with development of a synovial cavity in the fibrocartilage between the fourth and fifth vertebrae. Figure 16 shows the manner in which the head of the first rib is secured by a bony shelf in order to enable the swing of the shovel to be carried out most effectually.

Figures 17 and 18 show the changes which are produced in the manubrioclavicular joints in laborers who carry heavy loads upon the back or shoulder.

Figure 19 shows the manner in which the first costal cartilage reacts to the tremendous strain to which it is exposed. The cartilage becomes converted into bone and an arthrodial joint is developed in it. In the same figure are seen the new joints which form between the clavicle and the first costal arch and the coracoclavicular process. In Figure 20 the situation of these new developments is shown on the under surface of the clavicle.

Figure 21 and 22 represent the scapulae of an aged shoe maker and of a coal porter. Note the remarkable differences in the shape of these bones in consequence of

the very different strain to which they were exposed in these occupations.

Figures 23, 24 and 25 are the bones forming the elbow of the coaltrimmer. They afford excellent examples of the manner in which an old mechanism can be modified without the exercise of pressure or strain. It is immensely to the advantage of this laborer in the performance of his work that he should not have to control the movements of flexion and extension by muscular exertion. This is effected by the deposit of bone on the floors of the coronoid and olecranon fossae. In this manner the possible range of movement in this joint is limited to the special requirements of his occupation.

Figures 26, 27 and 28 show the developments that have taken place in the occipitaloid articulation and adjacent

vertebrae of an aged shoemaker. Among other changes there is seen a pillar of bone which has grown up from the lateral mass of the atlas and has formed an articulation with the under surface of the occipital bone. It is clear that this new mechanism has arisen without the action of pressure or strain with the object of minimizing the expenditure of nerve and muscle energy consequent on the jerk of the head when the thread is pulled forcibly and abruptly through the leather.

Figures 29 and 30 show many interesting changes which occur in the skeleton in extreme old age due to the absence of attitudes of extension and abduction and only to the presence of attitudes of flexion and adduction. The results of pressure and strain are well demonstrated in these instances.

EXPERIMENTAL HYDRONEPHROSIS, ARTERIAL CHANGES IN THE PROGRESSIVE HYDRONEPHROSIS OF RABBITS WITH COMPLETE URETERAL OBSTRUCTION<sup>1</sup>BY FRANK HINMAN M.D. F.A.C.S. SAN FRANCISCO CALIFORNIA  
AND

DUNCAN M. MORISON M.D. F.R.C.S. (EDIN.) EDINBURGH SCOTLAND

IN the mechanism of hydronephrosis arterial changes play a definite part. The degree of importance which they occupy in relation to the other causal factors cannot as yet however be fully determined. A previous contribution (2) showed the changes which occurred in the renal circulation as a whole during the development of hydronephrosis. Conclusions were drawn from experimentation on the rabbit, two methods being employed for vascular study—barium

sulphate gelatine and celluloid corrosion. The intention of this article is to illustrate more fully the arterial changes as demonstrated by the latter method celluloid corrosion, since by its means the altering phases are so graphically portrayed. The effect of surgical alterations in the blood supply upon the development of hydronephrosis has been presented in collaboration with Dr. A. B. Hepler (3).

## DETAIL OF EXPERIMENTAL PROCEDURE

Throughout the experimentation rabbits were employed. In one series the left ureter



Fig. 1. Diagram based on celluloid corrosion preparations showing the relation of the arterial circulation to the unilobed pelvis in the normal kidney of the rabbit. A Interlobar arteries—the primary subdivisions of the renal artery. B Arcuate arteries—the arched continuations of the interlobar trunks. C Interlobular arteries—which arise from the arcuate vessels and support the majority of the glomeruli. Since these cortical radicles are the parent stems of glomeruli their condition and presence or absence may be taken as indicative of function.

<sup>1</sup> From the Department of Urology and the Hooper Foundation

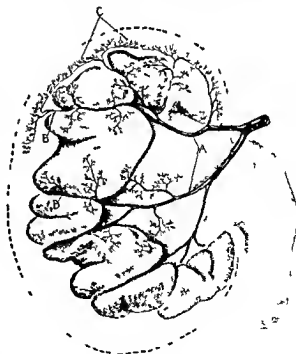


Fig. 2. Diagram based on celluloid corrosion preparations showing the relation of the arterial circulation to the unilobed pelvis in hydronephrosis of 35 days duration. A Interlobar arteries. B Arcuate arteries. C Interlobular arteries.

Division of Medical Research, University of California

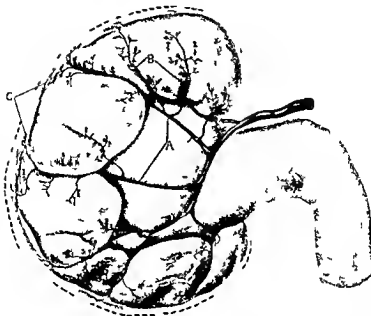


Fig. 3 Diagram based on celluloid corrosion preparations showing the relation of the arterial circulation to the unilobed pelvis in advanced hydronephrosis (about 70 days). A Interlobar arteries B Arcuate arteries C Interlobular arteries. The complete atrophy of all the finer arterial radicles excepting the few in immediate association with the larger trunks is here apparent.

was exposed through the lumbar route and divided between ligatures about centimeters below the sinus renalis. In the other series ligation and division of the left ureter were made above the bladder through a mesial transperitoneal incision.

The hydronephrotic changes produced by the two sites of ureteral ligation were similar except that to a certain extent the higher obstruction favored a more rapid development of the changes.

After total left ureteral obstruction animals were sacrificed at weekly periods from 7 to 70 days. Two animals were sacrificed at each period, in one an arterial injection alone was made and in the other the arterial injection was combined with that of both ureters.

Before the actual technique of celluloid injection was commenced each animal as sacrificed was carefully eviscerated through a mid ventral incision the esophagus above and the rectum below being divided between ligatures also the coeliac axis and the mesenteric

vessels. To allow freer access to the thoracic aorta the head and forequarters of the animal were resected by cutting circularly through the thorax about its middle. A loose simple knot ligature was then passed around the thoracic aorta about 1 centimeter from its divided end and another around the abdominal aorta just proximal to its bifurcation. No attempt was made at this juncture to skin the animal.

Prior to celluloid injection thorough irrigation with warm normal salt solution is made through the aorta until the outflow from the divided inferior vena cava comes clear.

Gentle massage of the kidneys during the irrigation favors more complete removal of the blood.

The ligature previously applied loosely around the abdominal aorta above its bifurcation is now tightened. The double injection technique was employed throughout the series injection being made into the thoracic aorta. The general procedure has already been

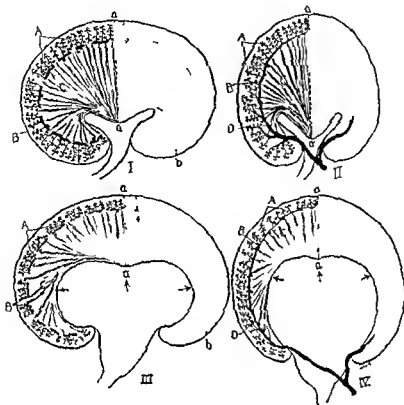


Fig. 4. Diagrammatic sections of kidneys of rabbit showing relationship of the arterial distribution to the zones of the parenchyma and the cavity of the pelvis. I and II. Longitudinal sections. III and IV. Transverse sections. I and II. Normal relationship. III and IV. Relationships when hydronephrosis has been present about 25 days.

1. Subcapsular zone or cortex corticis. 2. Cortex proper. 3. Cortico-medullary zone. 4. Medulla.

A. Interlobular arteries bearing glomeruli. B. Arcuate arteries. C. Arteria recta or the straight efferent capillaries of the lowermost glomeruli. D. Interlobular trunks.

In the sections of the normal kidney I and II observe the circumferential course pursued by the interlobular and arcuate trunks together with the polar arteries recta (Ia, b) in relation to the cavity of the pelvis and the process of lengthening they all undergo with pelvic distention.

The vessels which pursue a radial course, the interlobular and non-polar arteries recta (I and II a, a'), show the opposite change, that is, foreshortening and tortuosity (III and IV a, a').

described (2) and the following details refer more particularly to the application of the method to the present study. A 4 part celloidin solution (4 part celloidin, 100 part acetone) deeply tinted with alkanin was injected at a pressure of 600 millimeters mercury. After maintaining pressure for 10 minutes a 20 part celloidin solution is substituted and the pressure then kept at 400 to 500 millimeters mercury for fully 12 hours. During

the entire process of injection the specimen remains immersed in water.

When it was desired to obtain pelvic and arterial casts immediately following the arterial injection the ureters were injected with a 20 part colorless solution of celloidin at a pressure of about 80 millimeters mercury. The hydronephrotic pelvis was first emptied of its contents before the introduction of the injection mass. To obtain a good well filled

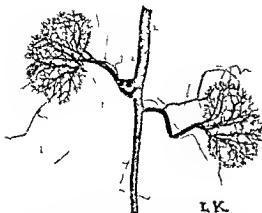


Fig 5 Normal renal circulation Cellulose corrosion preparation Rabbit Arterial injection made from thoracic aorta All branches of the abdominal aorta have been resected with the exception of the renal arteries and a few minor lumbar twigs The abdominal aorta itself has been divided about the level of the inferior mesenteric artery The specimen shows clearly the relationship of the renal arteries to each other and their manner of individual distribution L K Left kidney



Fig 6 Hydronephrosis of left kidney duration 7 days Cellulose corrosion preparation Rabbit Complete arterial and bilateral ureteral injection Left ureteral obstruction low On comparison the left kidney shows a dilated ureter with hypertrophy of its accompanying artery the general arterial distribution presents beginning rarefaction

cast of a large thin walled hydronephrotic sac is not easy with the cellulose corrosion method The degree of tension during injection requires careful supervision A slightly excessive pressure will rapidly produce rupture of the sac and extravasation whereas the employment of too little pressure will result in imperfect filling and an erroneous conception of the degree of pelvic dilatation

To ensure complete setting of the cellulose injection mass the specimen should be allowed to remain under water for fully 24 hours positive pressure being kept up throughout at the points of injection At the conclusion of this period the specimen is carefully skinned and placed in pure hydrochloric acid After corrosion in pure hydrochloric acid for 4 to 48 hours the cellulose casts are washed free from the digested tissues by a stream of water By removing all branches of the abdominal aorta other than the two renal arteries we could more clearly interpret the specimen

Since the cellulose corrosion preparations were made by injection through the thoracic aorta the injection mass was necessarily distributed evenly and simultaneously to both renal arteries Therefore the arterial changes

presented by the kidney with obstructed ureter may very readily be judged by comparison with the arterial structure of the opposite healthy kidney

#### ANATOMICAL CONSIDERATIONS RELATING TO THE RENAL PARENCHYMA

The parenchyma of the kidney presents four zones from without inward (1) subcapsular zone or cortex corticis (2) cortex proper (3) cortico medullary zone (4) medulla For the purposes of this article the relationship of the arterial distribution to these zones may be taken as follows

1 The subcapsular one contains only the efferent vessels and capillaries of the most peripheral glomeruli

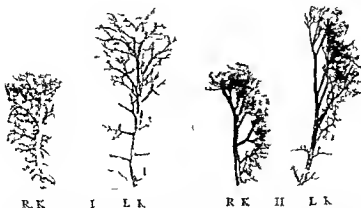


Fig. 7 Hydronephrosis duration 21 days. Celluloid corrosion preparations. Two corresponding interlobar arteries resected in their entirety from an individual preparation: the one from the right kidney (healthy) and the other from the left kidney (obstructed 21 days). The increase in length of the obstructed branch is apparent to either with its reduction in caliber and advancing obliteration of its ultimate interlobular radicles.

I As viewed from medullary aspect II Lateral view R.K. Interlobar artery from right kidney L.K. Interlobar artery from left kidney

2 The cortex proper contains the interlobular arteries which run for the most part parallel to each other and at right angles to the surface of the organ. From these interlobular arteries the vast bulk of glomeruli arise by short afferent branches.

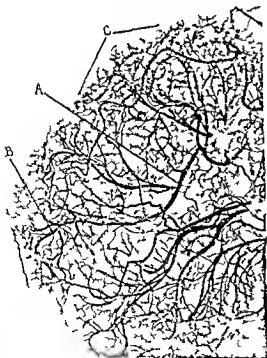


Fig. 8 Hydronephrosis of left kidney, duration 26 days. Enlarged view of outer portion of the kidney to show more clearly the lengthened and attenuated interlobar A and arcuate B vessels together with the interlobular branches C which are tortuous and foreshortened.



Fig. 9 Hydronephrosis of left kidney, duration 35 days. Arterial injection. The alteration in the finer radicles together with lengthening and thinning of the larger branches of the left renal artery are apparent on comparison with the vasculature of the opposite healthy kidney.





Fig. 10. Hydronephrosis of left kidney duration 35 days. Combined arterial and pelvic injections were made. In the affected kidney the circulatory changes are shown in their relation to the distended cavity of the pelvis. Two posterior interlobar arteries have been resected in order to reveal the degree of pelvic distention.

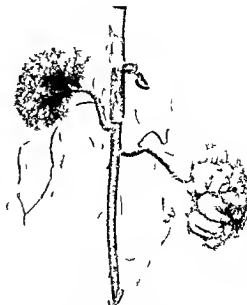


Fig. 11. Hydronephrosis of left kidney duration 56 days. Ligation of ureter. Combined arterial and bilateral ureteral injections. Note compression of the dilated calyx margins of the obstructed pelvis. The finer arterial radicles toward the outer border of the kidney are even at this period comparatively numerous though definitely impaired.

3 The *cortico medullary zone* contains the terminations of the interlobar trunks and their continuations the arcuate arteries. The origins of the interlobular branches are present in this zone since they arise from the convexities of the arcuate arteries and the lowermost glomeruli associated with them at this level together with the glomeruli which take origin directly from the arcuate trunks. The efferent vessels of the glomeruli situated in this zone descend in characteristically straight bundles into the medulla and are known as the *arteriæ rectæ*.

4 The *medulla* contains only the straight efferent vessels of the glomeruli of the cortico medullary zone. These efferent capillaries grouping themselves between the collecting tubules accompany them to their terminations in the papilla of the medulla.

The changes which each portion of the circulatory tree undergoes during the process of hydronephrotic distention and atrophy are

coincident upon the alterations in the various parenchymal zones.

The renal circulation pursues two directions in relation to the cavity of the pelvis or circumferential and radial. The interlobar and arcuate arteries may be said to pass around circumferentially whereas the interlobular arteries and the fine *arteriæ rectæ* (excepting those arising from the areas of the two poles) pass radially in relation to the renal pelvis.

#### THE ARTERIAL CHANGES AS OBSERVED IN THIS EXPERIMENTATION

With complete ureteral obstruction and consequent pelvic distention the renal parenchyma becomes compressed and then progressively displaced outward by the distending force within. When hydronephrosis is established the two changes which the parenchyma undergoes are coincident. At first however compression of the medulla as evidenced by recession of the papilla precedes the change



Fig. 12 Hydronephrosis of left kidney duration 56 days. Posterior view of left kidney resected from preparation in Figure 11. The changes which have occurred at this period in the arterial distribution in relation to the distended pelvis are evident.

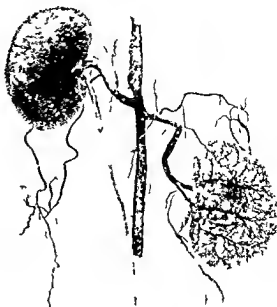


Fig. 13 Hydronephrosis of left kidney duration 49 days. Low ligation of ureter. Combined arterial and bilateral ureteral injections. The changes in the obstructed kidney are evident on comparison. The filling of the pelvis by the injection mass in this preparation is somewhat imperfect and accordingly the pelvis cast is smaller than it should be.

of displacement that is characteristic of the later phases.

It is evident that the first portions of the renal circulatory tree to be affected will be those that run radially to and from the cavity of the pelvis since these are passing in the same axis as the direction of force exerted by the distending pelvis.

With recession of the papilla the medulla becomes foreshortened and consequently the arteria recta traversing it also become foreshortened. The arteria recta however which pass from either pole run circumferentially to the cavity of the pelvis and these become stretched and laterally compressed.

With increasing pelvic distention compression of the parenchymal zones of the cortex cortices and cortex proper lead to rapid obliteration of the former and gradual impairment of the latter from without inward. The contained vessels of the cortex—the interlobular arteries—running radial to the direction of force are affected in the same manner

as the non polar arteria recta—they become foreshortened and accordingly tortuous their terminations being less resistant and more removed from the sustaining source of arterial pressure atrophy first.

Coincident with this phase there begins a gradual radial displacement of the parenchyma with consequent stretching of its constituent zones. It is manifest by a gross increase in size of the organ. An increase in circumference will be more acutely interpreted by structures which pursue a circumferential course thus the interlobar and arcuate arteries being subjected to a process of stretching become elongated. As elastic tubes on stretching lose the diameter of their lumina these arteries show a similar reduction in caliber. This change is probably responsible for a

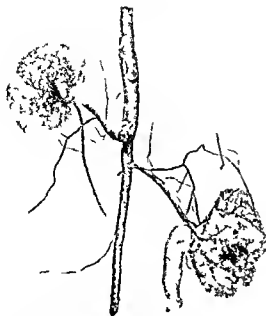


Fig. 14. Hydronephrosis of left kidney duration 6 days. Combined arterial and bilateral ureteral injections. The total size of the obstructed kidney in this specimen not much larger than that of the opposite healthy kidney but its vasculature shows marked atrophy.

diminished blood flow and ischemia which produces a lowering of tissue tone that hastens the stage of complete parenchymal atrophy.

It is evident that the ultimate ramifications of the arterial tree atrophy first and that the last to survive are the main trunks and their immediate branches. Atrophy proceeds centralward from the finer radicles where the blood pressure is low to the larger branches and finally attacks the main trunks the contained pressure of which being high resist complete obliteration.

As glomeruli are indicative of functioning tissue only those that arise from or are in the immediate proximity of arcuate arteries are capable of resisting for a time the atrophic process. Islands of functioning tissue in organs presenting advanced hydronephrosis are accordingly to be found in the lines of immediate distribution of the main arterial trunks.

Figures 5 to 15 inclusive are direct photographic reproductions of celluloid corrosion preparations. On the analysis of these specimens together with that of many others the

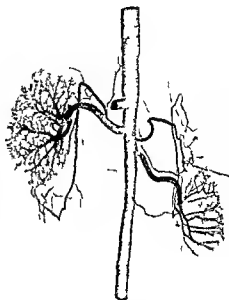


Fig. 15. Hydronephrosis of left kidney 143 days duration. Arterial injection. The gross size of the obstructed kidney is here relatively small and is associated with complete atrophy of all the finer arterial radicles (interlobular arteries) excepting in the immediate vicinity of the interlobar and arcuate vessels where a few origins of markedly altered interlobular twigs persist. A comparison between the circulations of the two kidneys is at this advanced period very striking.

description in the text is based. Four diagrams are included to facilitate explanation.

#### SUMMARY

1. The arterial circulation of the rabbit kidney is distributed in two different planes within the parenchyma in relation to the pelvis of the kidney. The main subdivisions of the renal artery pass around circumferentially whereas the finer branches are distributed radially to the cavity of the pelvis.

2. With the production of hydronephrosis the arterial circulation undergoes two phases of alteration. The first phase occurring at the onset is relatively short and appears for the most part to be a purely mechanical interference. In the second phase which soon supervenes there is in addition to this me-

chanical interference but consequent upon it a reduction of circulatory function which provides a contributing factor in accelerating the further development of hydronephrosis until ultimately complete atrophy is attained

3 With ureteral obstruction a renal pelvis commences to dilate. This produces progressive compression of the enveloping parenchyma. Since the finer arterial branches traverse the parenchyma in a direction radial to the cavity of the pelvis they are naturally subjected very early to a process of compression in their long axes and consequently become tortuous and foreshortened. Thus the first phase may be regarded as purely mechanical.

4 With continuing obstruction the renal pelvis assumes larger proportions achieved by definite displacement of the enveloping parenchyma. In this progressive change the gross size of the organ increases that is its circumference increases. Consequently all structures pursuing a circumferential course through the parenchyma will be subjected to a process of stretching or lengthening. Thus the major subdivisions of the renal artery

become gradually stretched. Since arteries are elastic tubes they become with stretching more attenuated and their lumina proportionately diminish. There ensues accordingly a reduced flow of blood through these channels leading to a state of ischaemia and thus by lowering tissue tone favors the progress of atrophy to its ultimate completion.

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## THE USE OF DIATHERMY AND OF THE QUARTZ LAMP FOR CONSERVING THE TEMPERATURE OF THE VISCERA AND PROMOTING THE WELFARE OF THE PATIENT BEFORE AND AFTER ABDOMINAL OPERATIONS

By C. W. CRILE, M.D., F.A.C.S., CLEVELAND, OHIO  
CL. I. J. CH. 22

THAT chilling the intestines produces a deleterious and warming a beneficial effect has always been known. That exposure of the abdominal viscera of itself alone may produce a fatal result has been frequently observed in the clinic and in the laboratory.

For the patient in shock the application of heat is a primary and most effective method of restoration. Zondek, Taylor and others have shown that the application of cold over the abdomen is more rapidly effective than the application of heat. According to Zondek,

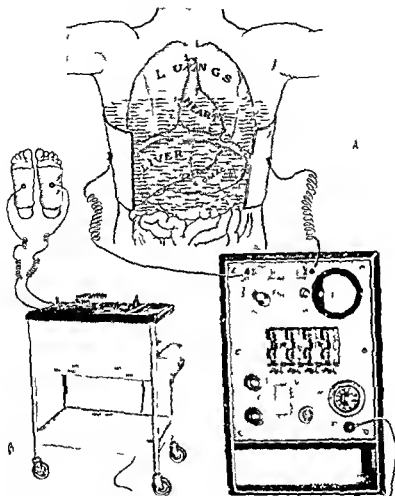
Our findings confirm those of Chelmonski, Wendinier and Schutze, Elchel and Schemel and others who conclude that cold applications to the body surface cause a lowering in temperature of the underlying organs and warm applications affect temperature to a less degree. Taylor found by means of thermocouples that heat penetrates to a greater extent through the abdominal viscera than through skeletal muscle but that in no case was the general body temperature raised by the local applications of heat. Stengel and Hopkins found that the application of ice bags over the gastric area produced an average drop of from 0.9 to 1 degree Centigrade in 45 minutes while the effect of hot water bottles in the same position for the same period was almost negligible.

These apparently anomalous observations indicate that the function of some vital organ or tissue has been depressed by the lowering of temperature caused by the application of cold; this fact explaining why the application of extensive hot packs is insufficient in some cases to overcome the result of the exposure of the viscera in the course of an abdominal operation.

An attempt to identify the organ the function of which is depressed by cold and a

search for some method whereby the depressing effects of cold upon the viscera might be obviated resulted in experimental researches which demonstrated that the liver is impaired by any condition which impairs the organism as a whole. In studies of variations in the temperature of various organs and tissues under many different conditions we found that the temperature of the liver together with the temperature of the brain fell progressively when the viscera were exposed the fall being comparable to that which followed the removal of the liver. These studies appeared to show that cold practically eliminated the essential function of the liver. Moreover we found that the removal of no other organ except the brain produced so marked an effect upon the organism as the removal of the liver which is followed by the rapid and steadily progressive failure of function of all the organs of the body. This effect is even more marked than that which follows the removal of the brain itself as if artificial respiration can be maintained the rest of the organism can survive for a longer time without the brain than without the liver. After removal of the liver the application of no known method of restoration or of conservation can check the steady decline of the organism to death.

We must conclude therefore that the liver is an organ which performs a major function in the organism, a function which is at least as essential to life as are the functions of the brain, the heart or the blood. It follows that to the extent to which the liver of a patient is functionally impaired to that extent is he unable to sustain an operation upon any part of the body and the surgical risk is increased if the surgical attack of itself further lessens the activity of the liver. In planning the management of surgical operations there



Schma'r drawing, showing application of diathermy to abdominal operations  
 A Position of electrodes during operation B Portable diathermy apparatus which can be wheeled beside or behind the patient to and from the operating room

fore it becomes of prime importance to know how the function of the liver can best be protected. This pertains to any surgical operation but it is of particular importance in abdominal operations and of prime importance in operations upon the liver and gall bladder and upon the common duct in particular.

Laboratory researches pointed the way to methods whereby the liver function could be protected against the chilling effects of exposure and its function maintained at or above the normal level during the critical first post-operative hours or days. It is a well known

biophysical law that a change of one degree in temperature changes the chemical activity of either a physical or biological system 10 per cent. It follows that when the temperature of the liver is reduced one degree its chemical activity is reduced 10 per cent. Therefore when the exhaustion incident to disease such as cancer of the stomach for example has reduced the chemical activity of the liver of a patient to 10 per cent of its normal activity, then if the temperature of the liver is reduced but one degree when the abdomen is opened death will follow inevitably.

In the course of our temperature measurements we found that when the abdomen was opened even if the liver itself was not directly exposed its temperature fell from 1.5° to 3 degrees or more and the impairment of the organism as a whole as a result of this lowered liver temperature was indicated by the fact that the temperature of the brain also fell from 1 to 3 degrees. This progressive fall in the temperature of the brain in these cases was identical with that which followed the removal of the liver. Moreover, in animals under ether anesthesia a similar lowering of the temperature of both the liver and the brain was observed. Under nitrous oxide anesthesia on the other hand the temperature of the brain and of the liver was but little altered. A lowered blood pressure induced by hæmorrhage also lowered the temperature of the brain and of the liver. That the organism as a whole cannot function in the absence of the liver function also was demonstrated by the lack of response of the brain to the injection of adrenalin after the liver had been removed. That is normally the brain responded to the injection of adrenalin by an immediate increase in temperature of from 0.5 to 1 degree but after the removal of the liver the injection of adrenalin produced but little or no change in the temperature of the brain. In view of these findings one can well understand why the mere exposure of the abdominal viscera may cause death in a very sick patient even if no operation has been performed and no general anæsthetic has been administered.

We can understand also why the addition of the general anæsthetic and of the operative procedure to the exposure of the intestines may cause the death of the patient who may not be so desperately ill.

This fatal sequence of events was illustrated on a large scale during the War by the effects of abdominal operations performed during the winter months in the front line hospitals where but few soldiers survived an abdominal operation especially when the operation required a wide exposure of the abdominal viscera. It apparently made no difference how skillfully the operation was performed.

Another remarkable fact established by our laboratory research was that the introduction

or application of heat within the abdomen which in most of our experiments was accomplished by the introduction of hot water into the stomach produced not only an immediate rise in the temperature of the liver but also a rise in the temperature of the brain and of special significance was the observation that the rise in the temperature of the brain occurred one minute or even more before the increase in the temperature of the liver was noted.

It would appear therefore that the application of heat to the liver by conserving the function of that organ should counteract the effect of the exposure of the viscera in an abdominal operation upon any patient and in particular in operations on the liver or on the bile ducts.

As stated above in the past attempts have been made to meet this requirement by hot water pads, hot tapes, the use of the hot water mattress and a superheated operating room but none of these methods has satisfactorily met this crucial need.

Recently it occurred to me that the application of diathermy would be an ideal method for holding the temperature of the liver at or above the normal level. The principle of diathermy is that the passage through the tissues of a current from a specially devised apparatus heats the tissues. Therefore it occurred to me that if one pole of the diathermy apparatus were placed upon the lower chest on one side and the other brought opposite the dome of the liver then the current would pass through the upper abdominal organs including the liver and since this current would be continuously applied during the operation the temperature of the liver and of the abdominal viscera in the track of the electric current would be maintained at or above the normal regardless of the exposure of the intestines. It must be borne in mind that on account of the enormous spread of the capillaries, veins and arteries very near the surface of the viscera the blood in the whole splanchnic area almost immediately assumes the temperature of the air to which it is exposed. It is almost as if the blood in one part of the circulation were spread out in a thin layer on a great table and were then

collected and again placed in circulation. By the passing of the diathermy current through the liver and the neighboring viscera this thin layer of blood would as it were be made to pass over a hot table so that warm blood would pass into the rest of the circulation.

In accordance with this conception we have been applying the diathermy current in certain bad risk cases. We have found that the electrodes can be put in place and the diathermy current established before the abdominal incision is made and that neither the surgeon nor the patient need be aware that such a current is passing.

We have found by actual observation that by this means the temperature of the dome of the liver can be maintained above normal throughout an operation in which the abdominal viscera are widely exposed.

The higher incidence of pneumonia after abdominal operations than after operations of an equal magnitude on other portions of the body is well recognized. In view of this fact and in view of the facts which we have cited one might well question whether this is not the result of the cooling of the blood in the important organs within the chest plus the general depressed function of the organism as a whole as the result of the cooling of the liver. We are therefore now noting whether or not the maintenance of a constant temperature in the liver and other abdominal viscera by the use of diathermy is lessening the incidence of postoperative pneumonia.

We are also using repeated doses of diathermy after operations in feeble and aged patients and after especially wide and prolonged exposure of the upper abdomen delivering the dose through the bases of the lungs as this is the area where postoperative pneumonia is initiated. In addition to the advantage of heat the increased temperature must induce a more active circulation in this area and thus increase the defense against infection.

Instead of delivering the dose directly through the bases of the lungs an effective method of maintaining the temperature of the whole organism and accordingly promoting circulation and general metabolism is secured by the passage of the diathermy current through the whole body by applying the terminals to the feet. The diathermy apparatus is so arranged that the terminals can be applied before the patient leaves the operating room the apparatus being wheeled beside or behind the surgical carriage to the patient's room where it remains as long as this treatment is indicated.

Comparable to the effect of the direct application of heat by the passage of an electric current through the resistant tissues is the application of radiant heat energy by means of the Alpine or quartz mercury lamp. Just as this has been found effective in cases of lowered resistance of tuberculosis and so forth we have found that it is equally effective when applied to anemic and cachectic patients whose general resistance has been lowered by prolonged wasting diseases.

By the application of these two physical methods which have long been used by the physiotherapist in certain conditions the surgeon has increased his armamentarium for the effective treatment of bad risk patients especially for the bad risk abdominal case.

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## MUSCLE AND FASCIA SUTURE WITH RELATION TO HERNIA REPAIR

By A. R. KOONTZ, M.D., BALTIMORE, MARYLAND  
From the Surgical Laboratory of the Johns Hopkins Medical School

**B**ECAUSE of the frequency of the occurrence and also the comparative frequency of recurrence inguinal hernia is ever a live and interesting subject. The percentage of recurrences given by various surgeons who have followed up their cases and compiled statistics varies widely. This difference is probably not so much due to a variation of operative procedure among surgeons or to a lack of skill as to faulty follow up methods and varied statistical procedures. Whatever the real percentage of recurrence is and this is difficult to determine it is conceded by many to be discouragingly high.

This admittedly high percentage of recurrence has led to many modifications of the original operations of Halsted (1889) and of Bassini (1890) for the radical cure of inguinal hernia.

In all operations for inguinal hernia one of the principal factors considered requisite for a cure is the effectual repair of the defective abdominal wall. In this repair our chief reliance for many years has been the suture of the internal oblique muscle and conjoined tendon to Poupart's ligament.

Is our reliance in this method of repair justified? Some operators (Coley and others) declare that in their operation for recurrent inguinal hernia they invariably find the internal oblique muscle firmly united to Poupart's ligament. On the other hand it is claimed by Seelig and others that in their operations for recurrent hernia Poupart's ligament is generally found smooth and glistening and entirely free from muscle attachments.

That this subject is a matter of importance in the cure of inguinal hernia goes without saying. Marchand in his classic work on wound healing fails to mention the union of muscle and fascia although he mentions almost every other conceivable condition of wound healing. Realizing the importance of

the subject Seelig and Chouke recently conducted a series of experimental studies on animals with a view to settling the question of the union of muscle and fascia. They used dogs and sutured a reduplication of the fascia lata without tension to the underlying muscle. In their interesting and copiously illustrated article they conclude that normal muscle will not unite firmly with fascia or ligament. It is therefore a useless procedure to suture the abdominal muscle to Poupart's ligament in the hope of buttressing a weak or ruptured abdominal wall. As fascia unites well with fascia they further conclude that the only logical course to pursue is to utilize some type of operation which depends upon fascia to fascia approximation for the repair of the defect.

The matter is of so much importance and the results and conclusions of Seelig and Chouke so revolutionary that it was felt that more experiments should be attempted in an effort to throw additional light on the subject. To this end we have performed 37 operations on dogs suturing muscle to fascia in several ways.

Most of the operations performed were ordinary hernia operations (except that there was no sac to tie off) the central feature of which was the suture of the internal oblique muscle to Poupart's ligament. The normal relation of these parts in the dog are shown in Figures 1 and 2. It will be seen that the angle formed by the internal oblique muscle and Poupart's ligament is greater in the dog than the angle formed by these structures in man. Therefore more tension is required on sutures which draw these parts into apposition in the dog than in man. Both catgut and silk suture material was used and mattress and interrupted sutures in different cases. The animals were sacrificed at intervals varying from 1 week to 9 months from the date of operation.

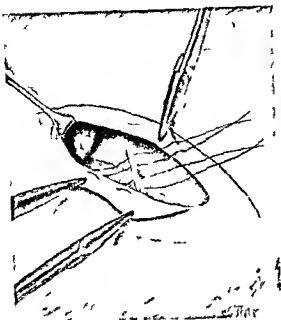


Fig. 1. The fascia of the external oblique is shown split and held back by Haldsted clamps revealing below the normal relationship of the internal oblique muscle and Poupart's ligament in the dog. Mattress sutures are in place ready to be tied.

In the operations as a rule 3 mattress sutures of silk or catgut were used to suture the internal oblique muscle to Poupart's ligament. The various structures of the region were first separated from each other by blunt dissection with the handle of a knife or a piece of gauze but were not traumatized any more than in the ordinary hernia operation in man. The conjoint tendon did not furnish the firm anchorage for the lower sutures that it does in man as this structure is of negligible importance in the dog. The fascia of the external oblique was sutured in some cases by a simple continuous stitch in other cases it was closed by overlapping the edges and careful suture by interrupted stitches. However it was shown when the animals were sacrificed that the method employed for the suture of the fascia of the external oblique had no effect on the union obtained between the internal oblique muscle and Poupart's ligament. Examples of the type of union obtained between these last named structures are shown in Figures 3, 4 and 5. It will be seen that there are definite bands of



Fig. 2. Both internal and external canals are here laid open. The left side shows the normal relationship of the structures as in Figure 1. On the right side the internal oblique muscle had been sutured to Poupart's ligament with 3 mattress sutures of No. 1 chromic catgut 2 months previously. The resulting union is clearly shown.

connective tissue uniting the ligament with the muscle and that in some places the pull of these bands is strong enough to draw bundles of muscle fibers away from their fellows and cause a bowing forward toward the ligament. The union of these structures was of so firm a nature that they could not be pulled apart without tearing the muscle.

Microscopic sections reveal the nature of this process of union between muscle and fascia. The union is the result of the interlacing and growing together of connective tissue fibers from Poupart's ligament and of similar fibers from the epimysium, perimysium and endomysium of the muscle. We have in effect then here a fascia to fascia union. The nature of this union is clearly shown in Figures 6, 7 and 8.

In one dog the iliac artery was injected with India ink before the structures were removed for microscopic section. On studying sections from this material under the microscope capillaries could be seen passing freely from the muscle coverings into Poupart's ligament. Further proof of the newly established continuity of these structures was thus established.

It is to be expected that Union such as that just described will take place very soon after



Fig. 3 Union between the internal oblique muscle and Poupart's ligament 2 1/2 months after operation. Three mattress sutures of No. 1 chromic catgut were used in making the sutures.

the parts concerned are brought into apposition. That this is true was shown by an experiment in which a dog was sacrificed just one week after operation and good healing was found to be in progress.

It is well known that in the repair of muscle wounds the muscle fibers themselves play

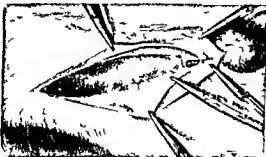


Fig. 5 Union of the internal oblique muscle and Poupart's ligament 2 months after operation. Note the downward bowing of the lower muscle bundles due to the pull of fibrous adhesions. Suture was accomplished by means of three mattress sutures of fine black silk doubled.



Fig. 4 Union of the internal oblique muscle and Poupart's ligament 1 1/2 months after operation. Three mattress sutures of fine black silk doubled were used in making the suture.

little or no part but the repair is effected by the connective tissue stroma which forms a firm scar. This scar is inseparable from the muscle being held in close and firm contact by the innumerable ramifications of the connective tissue stroma among the muscle fibers. With this in mind in three of our experiments before suturing the internal oblique muscle to Poupart's ligament we cut away a narrow strip of the surface of the muscle to be placed in apposition to the ligament and then sutured the raw surface to the ligament. The amount of fibrous union and scar tissue formation resulting in these cases was greater than in the others. This is what one would naturally expect as fibers of the ligament and the various fibrous components of the muscle are thus brought into more active contact and the fibers of the ligament incorporated in the scar with which the injured muscle is healed.

If then as these experiments clearly show union does take place between muscle and fascia how are the negative results of such reliable workers as Seelig and Chouke to be accounted for? Their work was carried out on the dog the fascia lata being sutured to the underlying muscle. Their method was as follows: By a 3 inch (7.5 centimeter) longitudinal incision at the anterior and upper portion of the outer aspect of the thigh the fascia lata was exposed and incised longitudinally for about 1/2 inches (5 centimeters). A free edge of the fascia was then folded back on itself in imitation of the

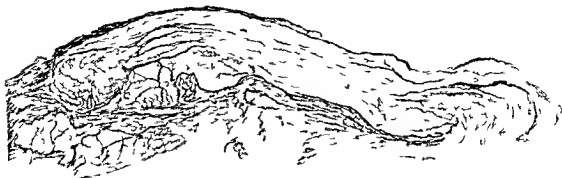


Fig. 6. Union of muscle and fascia. Transverse section through area of union shown in Figure 5 enlarged 25 diameters. Van Gieson's connective tissue stain.

reflection of the external oblique fascia to form Poupart's ligament. The reduplicated edge of fascia was then sutured to the underlying muscle. This suture of muscle to fascia was always carried out so that there was no tension whatsoever on the sutures in order to obviate all possibility of the separation of fascia from muscle by pull. When the animals in which this operation was performed were sacrificed it was found that the fascia was widely separated from the muscle to which it previously had been sutured. A very thin and translucent membrane of areolar tissue

bridged the gap between the edges of the fascia and the muscle.

On attempting to repeat the operation of Seelig and Chouke it was found that normally there is an intervening layer of areolar tissue between the fascia lata and the underlying muscle and the thought at once occurred to us that this was probably the reason for the nonunion of the two sutured structures. We therefore operated on both thighs of 4 dogs. On the right side of each we repeated the operation of Seelig and Chouke. On the left side of each we performed the same operation except that we first removed the intervening layer of areolar tissue and then sutured the fascia lata to the underlying muscle. On sacrificing these dogs the result on the right

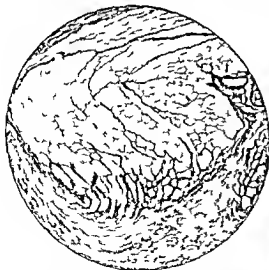


Fig. 7. A small portion of the transverse section shown in Figure 6 enlarged  $\times 80$  showing detail of the union of the fibrous components of the muscle with Poupart's ligament.

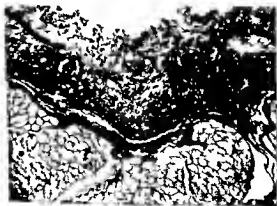


Fig. 8. Union of muscle and fascia. Photomicrograph of section through internal oblique muscle and Poupart's ligament 3 months after operation. Fine black silk doubled used as suture material. Van Gieson's stain 60 $\times$ .



Fig 9 Animal sacrificed 4 months after suture of fascia lata to underlying muscle by method of Seelig and Chouke. Silk sutures still in place but structures are united by only a delicate membrane of areolar tissue.



Fig 10 Animal sacrificed 4 1/2 months after suture of fascia lata to underlying muscle the intervening layer of areolar tissue being first removed. Firm union of the sutured structures.

side was found to be exactly the same as that described by Seelig and Chouke (Fig 9). However on the left side the fascia lata was found to be firmly adherent to the muscle (Fig 10) and microscopic sections showed the union to be of the same type as that described above.

A discussion of this subject should not be concluded without referring to the recent experimental work of Gallie and Le Mesurier. In a series of elaborate experiments which formed the basis for their use of living sutures in hernia repair these authors found that fascia readily unites with fascia the strength of the union depending upon the area of the surfaces in contact and state that

it was found that the surfaces placed in contact must be completely deprived of their sheath of areolar tissue otherwise the strength of the union will be very slight. Such surfaces should be thoroughly scraped and scarified in order that when healing does occur the new connective tissue may have a deep grip among the fibers. The importance of these observations is well demonstrated by the uniformity

of the success which attends step tenotomies and by the frequency of the failures which result from attempts to make side to side sutures of severed tendons. They indicate that in all operations in which it is intended to unite any of the fibrous tissues these tissues must be placed in actual contact with each other over a sufficient distance to make certain that the connective tissue which forms in the line of union will be sufficiently strong to withstand the anticipated strain. This means that in the case of aponeuroses and deep fascia the edges should be overlapped and in the case of the tendons when tenotomy is performed some form of step-operation should be employed. They further conclude that fibrous tissues heal to whatever structures they are placed in contact with by ordinary scar. The strength of this scar depends on the degree to which the surfaces which are in contact are denuded of areolar tissue and scarified and on the area of these surfaces.

Our own experimental results are in entire accord with these conclusions.

## SUMMARY

1 The internal oblique muscle and Poupart's ligament unite firmly in the dog when these two structures are brought into apposition by suture. This is in spite of considerable tension on the sutures.

2 The cutting away of a small strip of the edge of the internal oblique and thus making a raw surface tends to make the union firmer than usual.

3 When the fascia lata of the dog is sutured to the underlying muscle these structures unite firmly provided the intervening layer of areolar tissue has been removed.

4 Microscopic sections show that this union of muscle to fascia is accomplished by the growing together of the connective tissue fibers of the plane sheet of fascia (Poupart's ligament or fascia lata) with the fibers of the epimysium, perimysium and endomysium.

## CONCLUSIONS

These experiments show that muscle unites with fascia by the union of the fascia with the fibrous components of the muscle. The strength of this union depends upon intimacy of contact of the fascia with the fibrous com-

ponents of the muscle. It is necessary therefore that both muscle and fascia be stripped of areolar tissue before they are sutured together. Still better results are obtained if raw surface of muscle is sutured to fascia.

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## NECROSIS OF THE CORPUS LUTEUM OF PREGNANCY

By DORSEY BRANNAN M.D. AND MORTIMER COHEN M.D. PITTSBURGH, PEN. SYLVANIA  
From the William H. S. Germaine Research Laboratory of the Allegheny General Hospital and the Elizabeth Steel Maternity Hospital

AS the pathological findings in two very similar cases of pernicious vomiting of pregnancy were of such unusual nature the writers are prompted to record their observations. Brief case records are submitted.

The three well known indexes to the medical literature have been consulted regarding necrosis of the corpus luteum but nowhere have we found a reference to this subject. We also examined several of the more important papers concerning hyperemesis gravidarum and the pathology of the corpus luteum but were unable to find anything regarding necrosis of the corpus luteum. No doubt this lesion has been studied by others and probably described but the references are not accessible. Apparently then we are dealing with an uncommon lesion of some academic importance.

### CASE REPORTS

**CASE 1.** Mrs. Aurelia G., a white woman 27 years of age was admitted to the Elizabeth Steel Maternity Hospital April 22, 1924 on the obstetrical service of Dr. H. A. Miller and died April 24, 1924.

The complaint was persistent vomiting.

The past history was essentially negative aside from the usual childhood diseases. The menstrual periods began at thirteen years and recurred regularly every 28 days lasting 4 to 5 days. The onset of the last period which was apparently normal was February 8, 1924. The patient had been married 5 years but had not previously been pregnant.

The present illness apparently began on March 10 and was characterized by slight uterine bleeding lasting 2 to 3 hours. Soon after the bleeding she noticed nausea while preparing meals. Four days later there was again slight uterine bleeding for 2 to 3 hours accompanied by cramps. In the meantime she began to vomit. By March 25 nausea accompanied by vomiting had become very severe and 2 days later she called the family physician. The patient was put to bed and given alkali and a starchy diet. The vomiting grew rapidly worse until food by mouth was discontinued and nutrient enemata of glucose with soda were substituted. Still the vomiting persisted and the patient shortly became prostrated. The pulse rate reached 130 per minute on April 21 while previous to this time it had been 90 to 100 per minute. In addition glucose solution was given under the breasts and chloral

hydrate and bromides were used in the enemata but the patient remained unimproved. She was admitted to the hospital in a very serious condition.

The physical examination was limited to the pelvis because of the critical condition of the patient. The uterus was found to be the size of a grape fruit free and movable quite typical of an early pregnancy. The adnexa were normal. The cervix was posterior and soft. Blood was found on the examining fingers and there was evidence about the genitalia of previous bleeding.

Course in hospital. Because of the uncontrollable vomiting food and water were not given by mouth. Shortly after admission glucose solution was given intravenously, 500 cubic centimeters of a 25 per cent solution together with 25 units of insulin subcutaneously. The urine reacted for sugar, acetone and diacetic acid. The blood contained 200 milligrams of sugar and 23.7 milligrams of non protein nitrogen per 100 cubic centimeters.

On April 23 the patient appeared slightly improved and craved food and water but again she was given glucose and insulin as on the day before. The blood sugar was 147 milligrams per 100 cubic centimeters and the urine contained albumin but no sugar.

By April 24 the patient appeared to be somewhat improved and food and water were permitted by mouth. There was slight uterine bleeding but no cramps. Suddenly the patient became cyanotic and the pulse became very rapid. It died 10 minutes later. On the morning of April 24 the blood contained 166 milligrams of sugar per 100 cubic centimeters. Sugar was present in the urine but albumin was absent.

The temperature was irregular and varied from 98.5 degrees to 100.3 degrees F. The pulse rate was generally rapid and irregular throughout and varied from 70 to 170 per minute the latter rate being terminal.

The clinical diagnosis was hyperemesis gravidarum together with hyperglycemia, glycosuria, acidosis, slight albuminuria and uterine bleeding.

**Autopsy** (by M. C.) was performed 24 hours after death. The body was that of a well developed white woman. It was perhaps slightly edematous. The great omentum was adherent at numerous points to the parietal peritoneum. The stomach and small intestines were markedly dilated but the intestines and the appendix were otherwise negative in situ. The liver was lying free and well above the costal margin. The moderately enlarged uterus was lying free in the pelvis and extended 2 to 3 centimeters above the symphysis pubis. It was soft, boggy, very vascular and obviously gravid. The broad ligamentous veins were greatly dilated. The other pelvic and abdominal viscera were negative. No



Fig. 1. Low power photomicrograph of corpus luteum of Case 1 showing widespread coagulative necrosis. Irregularly all the lutein cells are necrotic.



Fig. 2. High power photomicrograph from the center of the upper half of Figure 1 showing a moderate leucocytic infiltration among the necrotic lutein cells.

evidence of peritonitis was found and there was no excess of peritoneal fluid.

Both lungs were found lying free, greatly distended and apparently very edematous. The thoracic viscera were otherwise negative in place.

The heart weighed 100 grams, was contracted and normal externally. The valves and chambers were negative. The thoracic aorta from a few fatty streaks was negative.

The right lung weighed 450 grams, the left 345. The large bronchi and the cut surfaces of lungs exuded much blood-tinged frothy fluid. The lungs otherwise were negative, aside from dependent congestion.

The liver and gall bladder weighed 1,060 grams. The liver was small, smooth, and pale in color with a few whitish capsular scars on the inferior surfaces. On section the color was slightly yellowish and homogeneous throughout. The consistency was normal. No watering of the parenchyma nor passive congestion was observed.

The gall bladder presented nothing abnormal and bile ducts were essentially negative.

The right kidney weighed 125 grams, the left 123. The organs were smooth and slightly congested. The cortex of each was swollen and dull. The pelvic structure of each kidney were negative.

The uterus presented the typical appearance of an early normal pregnancy. It was moderately enlarged, symmetrical, soft, red, and smooth. It measured 13 centimeters from cervix to fundus, 9 centimeters between the cornua, and 6 centimeters in thickness. On the posterior surface there were three small subserous myomata. The cervix presented nothing abnormal and the canal was tiny.

On section of the uterus the small fetus, umbilical cord, placenta, and membranes were found intact and the appearance was normal in every respect. The amniotic fluid was clear. The endometrium and myometrium presented nothing remarkable. The fetus measured 6 centimeters crown-heel length.

The ovaries were normal in size and shape and presented nothing pathological. The corpus luteum of pregnancy was found in the left ovary which measured 17 by 12 millimeters on the cut surface. It was yellow in color and presented no recognizable gross changes.

The uterine tubes were congested but otherwise negative.

The vagina was negative.

The upper small bowel was considerably distended but smooth and glistening. The lymph follicles and lymphoid patches of the ileum were prominent, appearing as whitish gray slightly elevated firm structures. The appendix and the large bowel were negative.

The stomach, aside from marked dilatation, was negative.

The other organs, namely the spleen, pancreas, urinary bladder, suprarenal capsules, breasts, and also the lymph nodes, revealed nothing of especial importance grossly or microscopically. The central nervous system was not examined.

Culture of the heart's blood showed no growth.

**Microscopic examination.** The material was fixed in Zenker's fluid and stained with hematoxylin and eosin.

Sections of the corpus luteum in the left ovary revealed extensive necrosis. The necrosis was irregular in distribution but involved at least half or more



of the lutein cells. In certain fields practically all the lutein cell between the strands of the supporting connective tissue were dead. The cells were diffusely and deeply stained with eosin and nuclei were not seen. The cell outlines of large groups of cells were fairly well preserved while the cytoplasm of some was granular and many cells were fragmented and certain others were undergoing liquefaction. The necrosis had the appearance of a coagulative necrosis. Scattered among the necrotic cells were many neutrophilic polymorphonuclear leucocytes and occasional large mononuclear phagocytic cells. In a few scattered foci a few red blood cells were intermixed. The lutein cells otherwise were pale more or less vacuolated and granular. Many of these cells were apparently degenerating but the nuclei remained vesicular. The cells nearer the blood vessels were perhaps a little better preserved but in places the necrosis extended up to the capsule and to the blood vessels. The corpus was very vascular and an occasional small hemorrhage was observed in the supporting tissue but none were found among the lutein cells. The vessels here presented no lesions but many contained a few leucocytes. About the periphery of the corpus luteum a few well preserved paralutein cells were found.

There were a few corpora albicantia in this ovary but no follicles. No evidences of inflammatory changes were observed and the ovary was otherwise negative. Several sections of this ovary presented the same appearance.

In the cortex of the right ovary there were several small atretic follicles with many interstitial cells the majority of which occupied the position of the theca interna and closely resembled paralutein cells. In one field numerous large and pale phagocytic cells were found about a recent corpus albicans. The ovary was otherwise negative.

The musculature of the uterus presented the normal uniform hypertrophy of pregnancy. In the decidua here and there an occasional gland was found containing thick fluid and occasional neutrophilic polymorphonuclear leucocytes. The leucocytes were not found among the decidua cell. No fibrin deposits were found aside from the normal canalized fibrin. The vessels of the uterus and decidua were numerous and large and a few small round cells were scattered about certain of the large sinuses. In addition another section showed a good deal of infiltrating hemorrhage involving the decidua which was otherwise normal in appearance.

The placental tissue was normal aside from one very tiny patch of infarction. The villi had a well defined double layer of epithelium the inner Langhans layer and the outer syncytium.

The liver cells especially those in the central portions of the lobules contained numerous large and small fat vacuoles. The central cell in many instances were reduced to little more than a cell membrane enclosing fat vacuoles. The immediate central cells in general were atrophic. The nuclei were not pyknotic and necrotic cells were not

found. The central capillaries were relatively large and apparently dilated but passive congestion was not a feature. The liver cells in the mid zone and periphery of the lobules revealed no special changes. Cloudy swelling was not a feature of importance. The bile ducts portal and hepatic vessels presented nothing remarkable.

The tubular epithelium of the kidney cortex was swollen and presented more or less the appearance of cloudy swelling. This however was somewhat modified by the presence of coagulated fluid in the lumina. The cytoplasm was granular but no colloid or hyaline droplets were found. Fat vacuoles were not observed. A fair number of cells had pyknotic nuclei but the cells were not necrotic. The epithelium was everywhere intact. The glomeruli were greatly swollen and the capillaries were engorged. The capsules of the glomeruli contained much thick fluid. The vessels of the medullary portions were congested but hemorrhages were not observed.

The essential lesions found in the lungs were extensive oedema and alveolar emphysema. The alveoli were dilated and even ruptured and practically all were filled with fluid and a few red blood cells. In places a few neutrophilic polymorphonuclear leucocytes were intermixed with the fluid which was indicative of a very early pneumonia. Black carbon pigment was abundant about the bronchial tree. There was also congestion.

The lymphoid tissue of the intestines was hyperplastic but there were no other changes.

The pathological diagnoses were pregnancy necrosis of the corpus luteum oedema of the lungs fatty changes of the liver parenchymatous degeneration of the kidneys hemorrhages of the decidua leiomyomata of the uterus omental adhesions and dilatation of the stomach and intestines.

CASE 2. Mrs. Mary W. a white woman of 47 years complaining of constant vomiting was admitted to the Allegheny General Hospital September 6, 1924 on the obstetrical service of Dr. J. L. Gurnore and died September 13, 1924.

The patient had had typhoid fever at the age of 11. Menstruation began at 15 years recurring regularly every 28 days but recently the period had become rather excessive. The last period was July 4, 1924. She had been married 19 years and had had 5 previous pregnancies the first 3 of which were normal. There was a probable toxæmia accompanying the third pregnancy characterized by vomiting and an operative delivery followed. The last two pregnancies were accompanied by vomiting and the patient induced abortion upon herself each time by the insertion of a foreign body into the uterus. No history of marked infection followed either manipulation. Otherwise the past history was negative.

The present illness began with vomiting in the latter part of August. Within a month the vomiting was protracted and food could not be retained. There developed about the time of the vomiting



Fig. 3 Low power photomicrograph of Case 2 showing extensive coagulative necrosis of the corpus luteum and liquefaction of the more peripheral cells. Note also the pale degenerating cells on the right and to the right of the large vessel. The infiltrating leucocytes are well shown.



Fig. 4 High power photomicrograph of another field of the corpus luteum of Case 2 showing a few infiltrating polymorphonuclear and mononuclear cells among the necrotic cells and an area of liquefaction at the edge of the field.

visual disturbances and vertigo. Edema was not noticed. The patient again tried to effect abortion by the introduction of a slippery elm stick into the uterus. This she did 2 weeks before admission to the hospital and a foul vaginal discharge promptly developed. The vomiting in the meantime became most severe and the patient lost about 20 pounds in weight. She had been exceedingly weak and confined in bed for 2 weeks or more before admission.

Physical examination showed a well developed middle aged white woman. Prostration and desiccation were marked. There was extensive oral sepsis, the mouth being dry and the tongue deeply furrowed. The thyroid gland was found moderately enlarged. The heart and lungs revealed no special abnormalities. The blood pressure was 126-74. The breasts were negative. The lower abdomen was slightly painful on palpation but otherwise negative. The genitalia showed evidences of previous lacerations and there was a thin vaginal discharge. The cervix was soft and admitted the index finger. The uterus was moderately enlarged soft and movable, the size of a 2 months pregnancy. The adnexa were painful and thought to be enlarged. The extremities and reflexes were negative.

Course in hospital. The patient had been unable to retain food or drink and the vomiting was most marked. Under sedative treatment however by September 9 the vomiting was less severe but her general condition was considered poor. Large amounts of glucose solution were given under the breasts. The blood contained 67.4 milligrams of non protein nitrogen, 1.4 milligrams of creatinine

and 140 milligrams of sugar per 100 cubic centimeters, white blood cells 18,150, red blood cells 5,68,000.

On September 10 the patient was able to retain a little food. The blood pressure was 118/82. The urine showed a trace of albumin and sugar and acetone were slightly positive. Bile was present and a few hyaline casts were found. The blood Wassermann was negative.

By September 11 the vomiting had practically ceased and the patient was able to retain a little food. The latter was given by stomach tube. Glucose solution was again given intravenously. The patient did not improve but gradually became lethargic. The blood pressure was 110-90.

Up to September 12 the temperature had been within normal limits but this day it rapidly rose to 102.4 degrees F. The patient became toxic delirious and slight jaundice was noticed for the first time. The pulse was exceedingly rapid, 156 per minute (ascutatory). A terminal diarrhoea developed and the patient died the next day.

The temperature was irregularly elevated after the initial rise of 102.4 degrees F and reached 103-105 and 107 degrees F before death. The pulse rate had been rapid throughout ranging from 150 to 126 per minute. The last 3 days the pulse rate reached 130 to 160 per minute. With the onset of fever the respiration became markedly accelerated, 40 to 60 per minute.

A clinical diagnosis was made of hyperemesis gravidarum accompanied by jaundice, desiccation, high non protein blood nitrogen, evidence of an

endometritis slight hyperglycemia with glycosuria and evidence of slight acidosis

Autopsy (by D. B.) was performed 17 hours after death. The body was that of a large well developed white woman. The skin and sclera showed a slight but definite jaundice. The moderately enlarged thyroid gland produced a noticeable fullness in the neck. The breasts, thorax and abdomen were negative. The external genitalia were bluish and multiparous. A thin brownish fluid exuded from the vagina. The body was otherwise negative externally.

The soft and moderately enlarged uterus was lying free in the pelvis, the fundus just reaching the symphysis pubis. The adnexa were essentially negative *in situ*, as were the abdominal viscera. No evidence was found of peritonitis and the peritoneal cavity presented nothing of importance pathologically.

The thoracic cavity, with the viscera in place, was negative.

The heart, weighing 250 grams, was contracted and externally normal in appearance. The chambers and valves were negative. A few fair sized yellowish atheromatous plaques were found in the aorta. Otherwise the large arteries and veins were negative.

The right lung weighed 450 grams, the left 460. Both lungs were moderately edematous, exuding from the cut surfaces much frothy fluid. The dependent portions of both lungs were congested. No definite bronchopneumonia was demonstrated.

The thyroid gland weighed 125 grams, was considerably enlarged, nodular and distorted. It almost surrounded the trachea, but did not compress it. Numerous adenomata, for the most part made up the enlargement, the largest of which was 4.5 by 3.5 by 3.5 to 4 centimeters. On the cut surfaces the appearance of the adenomata was typical and some were partially calcified, others showed central softening, but none were cystic. The intervening tissue had large alveoli which contained much pale glassy colloid.

The liver and gall bladder weighed 1,470 grams. Externally the liver presented nothing pathological. On section the liver parenchyma as well as the capsular surfaces were uniformly dark in color. The lobules were not especially swollen and no scarring or other alterations were observed.

The gall bladder was thin walled and contained no stones and the bile ducts were negative.

The right kidney weighed 165 grams, the left 150. Aside from the purplish discoloration of congestion both kidneys were negative externally. On section they oozed much blood, but both were soft. There was slight swelling of the cortex of each kidney. The pelvic structures of each were negative.

The uterus was the size of a 3 months pregnancy, symmetrical and soft. Its surfaces were smooth and glistening except for a small patch of superficial veins forming a roselle situated on the fundus. The cervix was soft and revealed a healed bilateral laceration. Thick mucus exuded from the patulous external orifice. On section of the uterus the fetus

was found floating in clear amniotic fluid. The fetal membranes and placenta presented nothing pathological. The uterine muscle and the decidua were very vascular but appeared to be normal. The cervical tissue was dense and was cut with difficulty.

The fetus was 4.5 centimeters crown rump length and appeared normal. The umbilical cord was not remarkable.

The right ovary was larger than the left due to the presence of the corpus luteum of pregnancy in the median pole. No gross changes were recognized in the corpus, which had a uniform light yellow color. The ovarian tissue of the right ovary was soft. The left ovary was not grossly pathological.

The uterine tubes were essentially negative.

The vagina was negative.

A small firm lobulated and gray nodule 11 by 6 millimeters with the appearance of an accessory pancreas was found on the free surface of the upper jejunum. The large bowel and appendix were negative.

The bone marrow of the right femur was abundant and reddish brown in color.

The other organs, namely the pancreas, spleen, suprarenal glands, breasts, urinary bladder and stomach, revealed nothing of special importance grossly or microscopically. The lymph nodes were negative. The central nervous system was not examined.

Culture of the heart's blood revealed no growth.

*Microscopic examination.* The material was fixed in Zenker's fluid and stained with methylene blue and eosin.

The sections of the corpus luteum in the right ovary revealed extensive necrosis. Large patches of cells the nuclei of which were hardly recognized had undergone coagulative necrosis. Among them were scattered a few neutrophilic polymorphonuclear and endothelial leucocytes. Occasional tiny fibrin deposits and elsewhere a few red blood cells were also found among the coagulated cells. About the periphery of these large patches the dead luteal cells were undergoing fragmentation and extensive liquefaction. Nowhere however were the nuclei pyknotic. In the blood vessels which were unmyelinated a few neutrophilic polymorphonuclear leucocytes were also found. The corpus was very vascular but there were no hemorrhages. About certain of the vessels the luteal cells were fairly well preserved and in a few places they appeared unchanged. The center of the corpus luteum was occupied by a small cavity containing coagulated fluid, the lining of which was of fibrous tissue. The supporting and capsular tissues of the corpus luteum presented nothing unusual. The few paraluteal cells about the periphery showed nothing remarkable.

A very slight chronic peripheral inflammation was found which was characterized by a few buds of organized exudate infiltrated with a few mononuclear cells. The superficial cells of the meso-ovarium at one point and many cells in certain of the patches of organized exudate had undergone a very definite decidual change.

The left ovary had a fair number of interstitial cells in the walls of the atretic follicles. Inflammatory changes were absent.

The uterine muscle presented a uniform and well marked hypertrophy characteristic of pregnancy. The musculature under the placenta was very vascular. The decidua especially in the superficial portions had various large patches of exudate composed of neutrophilic polymorphonuclear leucocytes with scattered fibrin deposits in addition. Where the exudate was abundant small patches of decidua were necrotic. One large sinus was found acutely thrombosed. The deeper layers of the decidua and glands were free from inflammatory changes. A few of the basal glands contained a thick fluid. The tissue was also more or less oedematous. Otherwise the decidua was negative.

The placenta was not pathological and both layers of epithelium covering the chorionic villi were easily differentiated.

The cervix of the uterus showed extensive inflammatory changes characterized by a marked infiltration of plasma cells especially in the mucosa. The cervical epithelium was hyperplastic and thrown into low papillary like growths. Between the epithelial cells and also lying in the glands were numerous neutrophilic polymorphonuclear leucocytes. Several tiny cysts or occluded glands were scattered about. An ulcerated patch covered by a leucocytic and fibrinous exudate was found at the external orifice. A moderate lymphocytic infiltration was found in the subepithelial tissues of the vaginal portion of the cervix. The musculature of the cervix was also hypertrophied.

The liver cells about the central veins were atrophic. A fair amount of coagulum was lying between the vessel walls and the liver cells throughout the greater portion of the lobules but it was especially well marked centrally. Many of the central cells had pyknotic nuclei and some were fragmented. Here and there an occasional necrotic cell or cells were observed surrounded by a few neutrophilic polymorphonuclear leucocytes. The majority of the central cells contained many small fat vacuoles. Other cells found in the central areas were reduced to little more than shadows, the cytoplasm apparently having been largely replaced by fat. The nuclei of these cells were pale. The central and the more peripheral cells as well contained a fair amount of finely granular yellowish pigment. The more peripheral and mid zone cells showed very little change aside from a few tiny fat vacuoles. No passive congestion was observed. The bile ducts presented no evidence of obstruction and the sections were otherwise negative.

The cytoplasm of the epithelial cells of the cortex of the kidney was granular and the cells were swollen and irregular. Certain nuclei were pyknotic but no necrotic cells were observed. The tubules of the superficial cortex were dilated and contained a honey combed coagulum, a portion of which at least came from the cytoplasm of the lining cells. Elsewhere the

changes were more or less typical of cloudy swelling or parenchymatous degeneration. The collecting tubules of the medulla contained a few hyaline casts. The glomeruli were swollen and congested and contained a honey combed coagulum. The blood vessels were generally engorged but there were no hemorrhages. No evidence was found of acute nephritis or fatty changes. Otherwise the sections were negative.

The large adenomata of the thyroid gland presented essentially the same picture. They were made up of small closely packed and well preserved alveoli especially about the periphery while the centers were largely loose fibrous tissue degenerating alveoli and thick fluid. There was no evidence of hyperplasia of the alveolar epithelium, the cells of which were small and fairly uniform in size. Colloid was slight in amount. The capsules were composed of dense fibrous tissue. The smaller adenomata had poorly defined capsules, larger alveoli and the colloid here was not especially abundant.

The thyroid tissue proper was made up of large and irregular alveoli with flattened lining epithelium containing much colloid. Here the picture was suggestive of a colloid goiter. In certain of the larger alveoli were tiny intracystic papillomatous growths with a few scattered patches of small round cells. A few such cells were found in the adenomata.

The sections of the lungs showed a widespread oedema and a very fresh terminal bronchopneumonia. No tuberculosis or other chronic disease was found.

Sections from the small body on the jejunum revealed lobules of accessory pancreatic tissue apparently functioning. The pancreatic ducts and islet tissue were well defined. Otherwise the intestine was negative.

At one point there was a slight ulceration of the mucosa covered by a superficial leucocytic exudate. The lumen contained a fair number of neutrophilic polymorphonuclear leucocytes. No mononuclear exudate was observed. Otherwise the appendix was negative.

Bone marrow sections showed a diffuse and moderate degree of hyperplasia of the white and red blood cell elements.

The pathological diagnoses were pregnancy, necrosis of the corpus luteum, adenomata of the thyroid, jaundice, oedema of the lungs with a very early acute bronchopneumonia, fatty changes and oedema of the liver with a few necrotic central cells, parenchymatous degeneration of the kidneys, acute decidua endometritis, acute ulcerative and chronic cervicitis with old lacerations, acute ulcerative appendicitis and accessory pancreas.

In the first case the subject was a primipara who presented the clinical features of pernicious vomiting in the third month of pregnancy. The illness was acute and progressive terminating in death 44 days after the onset. The hyperglycemia and glycosuria were

certainly the result of the liberal therapeutic use of glucose solution. The acidosis, as revealed by the urinalysis was obviously the result of starvation. The albuminuria was apparently not marked. The uterine bleeding was not the result of an endometritis, and perhaps might have been the onset of a threatened abortion, had the patient lived long enough. Toward the end tachycardia and later fever developed. Unfortunately no blood pressure readings were available.

Aside from marked pulmonary edema the postmortem examination so far as the gross findings were concerned revealed little of significance. Microscopically the extensive coagulative necrosis of the corpus luteum constituted by far the most important lesion. Certain of the lutein cells near the blood vessels were not greatly altered and seemed to be somewhat protected by their position. The liver revealed fatty changes but not the usual central necrosis. The kidneys presented very definite parenchymatous degeneration but nothing especially characteristic.

In the second case the clinical picture was also that of pernicious vomiting in early pregnancy. This patient was a multipara in the third month of gestation. When the patient entered the hospital after 2 weeks of almost constant vomiting she showed evidence of desiccation and loss of weight. When she was first examined her condition was regarded as serious and the duration of the illness was less than a month. The presence of jaundice and the high non protein nitrogen of the blood were unusual features worthy of note. The rapid pulse and fever were apparently terminal events. The high red and white blood cell counts were no doubt due to concentration of the blood from the loss of fluids. The leucocytosis at least in part was possibly associated with the acute endometritis. The slight hyperglycemia and glycosuria as in the first case is to be attributed to the therapeutic use of dextrose. Here again one sees evidence of a slight starvation acidosis as shown by the presence of acetone in the urine. Albuminuria was very slight. There was no hypertension.

With the exception of edema of the lungs and the adenomatous goiter the autopsy findings were not remarkable.

The important lesions microscopically were in the corpus luteum and in the liver and the decidua. The acute decidual endometritis certainly followed the introduction of the foreign body into the uterus. The infection had not spread to any extent and apparently it was rather a low grade process. The chronic inflammatory lesions of the cervix appears to have been of long standing while the acute exacerbation and ulceration were no doubt caused by the slippery elm stick.

The acute ulcerative appendicitis was not extensive and of little significance.

The pathological findings in the liver were not extensive yet definite. There was a moderate degree of fatty changes in the central cells and in occasional lobules one or more necrotic cells were observed. The liver was also edematous. The cause of the jaundice remains obscure as the liver damage was hardly sufficient to explain it. Apparently then it should be considered of extrahepatic origin.

The kidneys did not present the characteristic necrosis of the tubular epithelium but essentially a parenchymatous degeneration. The kidneys showed no evidence of nephritis and the high non protein nitrogen of the blood remains unexplained.

The massive necrosis of the corpus luteum was by far the most marked lesion found. Rather extensive liquefaction of the dead lutein cells in this case is perhaps in favor of necrosis of longer duration than is that in the first case. The necrosis in this instance as in the first case represents an uncommon local degeneration. No other ovarian tissue was affected in either case but occasional capillaries of each corpus luteum were evidently slightly injured.

Two very similar cases of pernicious vomiting of pregnancy both terminating in death revealed for the most part a similar disease condition especially of the corpus luteum. Both cases presented the rather characteristic fatty changes of the liver however in neither instance were the livers enlarged. Only in the second case were there necrotic central liver cells and these were not numerous. Central necrosis of the liver though often observed is not a constant finding in this disease. The

frequently found necrosis of the renal tubular epithelium was absent in each case. The lesions of the kidneys of neither were characteristic and were not unlike the degenerative changes occurring in any acute infectious or toxic disease.

The question at once arises as to the significance of the necrosis in the corpora lutea. From the appearance of each corpus luteum it seems probable that many of the necrotic cells had been there some time sufficient time at least for these cells to have undergone a certain amount of fragmentation and liquefaction. Especially was this true of the second case. On the other hand leucocytic infiltration in this case was only slight. In the first case, leucocytic infiltration among the necrotic cells had advanced to a moderate degree yet the majority of the cells maintained their form fairly well. The necrosis in both instances was primarily a coagulative necrosis. In neither case was there any evidence of repair. The form of each corpus luteum had been well preserved by the fibrous tissue framework. On the whole in view of the gross and microscopic findings it appears that the bulk of the necrosis was not of long duration and hence occurred late in the disease.

The necrosis in these cases probably resulted from the underlying toxæmias of which the patients suffered. It therefore apparently belongs in the same category with the central necrosis of the liver cells and also with that of the epithelium of the convoluted tubules of the kidneys either or both of which may be found in this malady. Aside from the short life of the corpus luteum there are no reasons

why one should not expect necrosis of the luteal cells as well as that of any other parenchymatous structure. But why the necrosis should be so extensive in the corpus luteum and very slight or absent in the liver and kidneys where it is usually found is a question we cannot answer.

Realizing that the etiology of the toxæmias of pregnancy and particularly that of pernicious vomiting is obscure we do not propose to offer the necrosis and the obvious deficiency of the corpus luteum as the underlying cause of this disease. Certainly two cases cannot prove this point. It may be that this lesion of the corpus luteum is well known to some and perhaps has occurred in conditions other than hyperemesis gravidarum.

Obviously in these two cases there must have been a marked deficiency of the corpus luteum secretions. But how long this deficiency persisted and the character of the disturbances it no doubt caused are things we do not know.

It is to be hoped that, in the future pathologists will routinely study the corpus luteum of pregnancy, whether or not it appears grossly pathological.

#### CONCLUSIONS

1. Necrosis of the corpus luteum may occur in pernicious vomiting of pregnancy.
2. Necrosis of the corpus luteum in pernicious vomiting of pregnancy probably has the same significance as has necrosis of the liver and kidneys in this disease.

We wish to thank Drs. James L. Gilmore and Harold A. Miller for the privilege of using the clinical records.

## THE CORPUS LUTEUM AS THE SOURCE OF THE FOLLICULAR HORMONE

By CHARLES G. JOHNSTON, M.D., St. Louis, Missouri

Department of Surgery, Washington University School of Medicine

AND

VICTOR L. GOULD, M.D., St. Louis, Missouri

Department of Biology, Washington University School of Medicine

SINCE Knauer (1899) proved by transplantation experiments that the action of the ovary on the genital tract was due to a hormone, a decided interest has been taken in the task of localizing the origin of this hormone in the various distinct tissues of the ovary. The follicle, interstitial cell, and corpus luteum have been cited as possible sources of it.

The idea that the corpus luteum is the tissue producing the hormone of the ovary was first suggested by Born and Fraenkel (1903). They believed the corpus luteum to be responsible for the implantation of the ovum and, in some way, to cause menstruation. Fraenkel tested the relation of the corpus luteum to the implantation of the ovum by extirpating the corpora lutea of pregnant rabbits and noting that the pregnancy was terminated if the operations were performed in the early days of pregnancy.

Loeb (1907) considered the corpus luteum necessary for the implantation of the ovum because of his studies on the production of deciduomata in the uterus of the guinea pig. He found it possible to produce deciduomata in the uterus by mechanical stimulation only at one period following oestrus, namely when the corpus luteum had reached its greatest development. Loeb considers the effect of the corpus luteum to be that of a sensitizing agent rather than a factor in nutritional control as Fraenkel pointed out.

Ancel and Bounin (1910), working with the rabbit, confirmed Loeb's work. They allowed females to copulate with vasectomized bucks and noticed that corpora lutea were formed and that certain changes occurred in the uterus. These changes were considered as a preparation for the reception of the ovum.

That there is more than one ovarian hormone seems to be probable. However, in this

paper we are concerned only with the hormone found in the follicles and wish to ascertain whether or not this hormone is also found in the corpus luteum.

Herrmann in 1913 claimed the isolation of an unsaturated phosphatide which caused oestrus changes but later altered his opinion about the character of the substance. Fellner (1913) also claimed the isolation of the female sex hormone as a lipid. Fellner and Herrmann have since entered into a controversy as to the priority of the discovery of this hormone in the corpus luteum. Both of these men claim to have found a hormone causing hyperplasia of the genital tract in whole ovaries, corpus luteum, and placenta. The test animals used in their experiments were sexually immature female rabbits.

Frank and Rosenbloom (1915) tested the action of extracts of corpus luteum by lipid solvents on the genital tract of female rabbits and found an increase in the length, diameter, and weight of the uterus following subcutaneous injections. A very decided difference was noted in extracts of corpora lutea from ovaries of pregnant hogs as compared with those obtained from non-pregnant animals. Extracts of the latter did not cause an increase in the size of the uterus while the former gave a positive reaction. The ovaries for this experiment were collected by the packing company and it is interesting to note that the extract of corpora lutea from one batch of ovaries which inadvertently had been degenerated by the packing firm gave only negative results.

Although Fellner, Herrmann, and Frank and Rosenbloom all obtained positive results in inducing uterine hyperplasia with corpus luteum lipid extracts, Okinschitz (1914) could obtain only negative results with his extracts.

The work of Allen and Doisy (1923) with the follicular hormone raised the question in our minds as to the production of the same hormone by the corpus luteum. We were especially anxious to test corpora lutea from swine on ovariectomized white rats in exactly the same manner in which such favorable results were obtained by Allen and Doisy with liquor folliculi. Hog corpora lutea the principal source of the commercial extract, were generally used although a few tests were made on sheep and cow corpora lutea.

#### EXPERIMENTS

Our first consideration was for the certainty of the tissue with which we were dealing. The necessity for careful collection of our material was impressed on us by the fact that one of our associates obtained a slightly positive result with an extract of corpus luteum made from ovaries which had been carelessly collected by a laboratory diener and allowed to stand for a time. We felt that we could not correctly say that our extract was from the corpus luteum unless we took care that there were no other tissues present and that there was no chance for postmortem diffusion of substances from other tissues into the corpora extracted. In order that we might rule out this possibility of contamination with other tissues we gathered corpora lutea from hogs which had been alive but a few minutes before we clipped and rinsed the tissue.

The corpora lutea gathered in this way were then grouped as to size consistency color and condition of the accompanying uteri. In some preparations we were careful to determine whether the hogs were pregnant or not and, if pregnant to note the size of the embryos present. The corpora lutea from pregnant animals were grouped into three groups (1) Those having embryos up to 30 millimeters in length (2) those having embryos up to 50 millimeters in length and (3) those having embryos over 50 millimeters in length. We think by this careful collection that we have reduced to a minimum the danger of contamination of our material with substances from other parts of the ovary and that we are dealing with the corpus luteum alone.

TABLE I—INJECTIONS OF CORPUS LUTEUM EXTRACTS INTO OVARIECTOMIZED RATS<sup>1</sup>

Prep. No.	Kind of corpora lutea	Amount injected tissue (gms.)	No. of tests
19	Large red	10	2
45	Red solid various fractions tested		6
77	Large red		1
89	Large red	60	2
103	Mixed pregnant and non pregnant	25	1
104	Mixed pregnant and non pregnant	20	1
105	Mixed pregnant and non pregnant	13	1
106	Mixed pregnant and non pregnant	20	1
113	Solid pink	20	2
113a	Acetone fraction of 113		1
114	Solid pink	12	4
117	Non pregnant solid pink	10	3
119	Non pregnant yellow fibrous	4	1
121	Pregnant red embryo 5 to 30 mm	20	3
123	Pregnant red embryo 35 to 50 mm	12	1
124	Pregnant red embryo over 100 mm	10	3
125	Pregnant red embryo 5 to 50 mm	0	2
129	Pregnant red embryo 50 to 125 mm	25	2
130	Non pregnant large pink solid	20	1
127	Non pregnant large pink solid	0	1
133a	Pregnant red embryo 40 to 125 mm (Putrefied by alkaline hydrolysis)	20	1
165	Mixed red	0	1
199	Mixed red purified by alkaline hydrolysis	35	1

<sup>1</sup> The results are given in experiment 1.

The extracts were made by the procedure described by Doisy, Ralls, Allen and Johnston (1924) which consists essentially in the precipitation and extraction of the proteins with alcohol and subsequent purification with acetone and ether. As negative results are of doubtful value unless the experiments are adequately controlled, preparations from liquor folliculi and corpora lutea were made simultaneously by exactly the same technique. Preparations No. 133a and No. 199 were made by mild alkaline hydrolysis and the non-saponifiable fraction was carefully purified. Its injection likewise produced negative results. This was done because the activity of the liquor folliculi preparations seemed to increase with the purification of the extract. Ovariectomized white rats and immature rabbits were used as test animals. For the estimation of activity in the rabbit we used a



TABLE II—INJECTION OF OVARIAN EXTRACTS INTO NORMAL IMMATURE RABBITS

Litter m t s	Rabbit N	Pregnant No	Tiss. extracted	No. of d 24 injected	Amount of extract d 24 injected	Age (m) in wks.	Length in mm of torn horn	Diameter of uterus mm	Condition of internal genitalia	Remarks
A	857	143	Red corpora lutea	7	77 gm	5.5	50	1	Uterus oviduct and vagina small and anemic	-
A	858	144	Liquor folliculi	7	77 gm	5.5	80	4	Ovaries and tubes small uterus and vagina large	++
A	859	145	Remains of ovaries from which No 143 and No 144 were taken	7	77 gm	5.5	60	3.5	Uterus hyperæmic and slightly enlarged	+
A	856		Control animal		0	5.5	60	2	Uterus slightly pink vaginal wall thin	-
B	853	147	Residues from pregnant corpora lutea No 127 No 128 and No 129 (See Table I)	5	67 gm	6	40	2	Uterus and tubes small and white	-
B	852		Control animal		0	6		1.5	Uterus small	-
C	816	447	No 147 (see above) and No 110	6	75 gm	7		2	Uterus small and white	-
C	819	110	Liquor folliculi (highly purified) Total solids 8 milligrams	6	0	7		4	Uterus enlarged and slightly pink	+
C	818	357	Liquor folliculi and corpora lutea No 110 and No 147	6	0	7		4.5	Uterus enlarged and slightly pink	+
C	817		Control animal		0	7		1.5	Uterus small and white	-
D	820	147	Corpora lutea (see above)	4	50 gm	4.5		0.8	Uterus very small animal died 4th day with diarrhoea	-
D	821	110	Liquor folliculi (see above)	4	10 gm	4.5		2.5	Uterus and vagina enlarged and slightly pink	+
L	822	158	Corpora lutea red mixed	8	80 gm	7		3	Uterus hyperæmic animal died Cause	+
E	824	110	Liquor folliculi (see above)	8	75 gm	7		5	Uterus very large slightly hyperæmic	++
E	854		Water soluble commercial preparation of whole ovaries	8	0	7		1.5	Uterus small and anemic	-
E	825		Control animal		0	7		2	Uterus small and anemic	-

comparison of the condition of the genital organs of injected and uninjected litter sisters. For the rat we used the test originated by Stockard and Papanicolaou (1917) for the guinea pig and described as being equally suited for the rat (Long and Evans 1922) mouse (Allen 1922) opossum (Hartman 1923) and monkey (Corner 1923). The test consists essentially in the examination of the vaginal smear which presents a very characteristic picture in the various phases of the œstrus cycle. It is possible by this method to follow closely in the living animal changes occurring in the genital tract.

In our experiments injections were made in three portions during the day the injections usually being about 4 hours apart. Tests of 42 extracts of corpus luteum were made in varying amounts. In no case was there a positive result with corpus luteum extract regardless of the type of corpora lutea or quantity used. However by a perusal of the protocol it will be noted that from liquor folliculi and whole ovary extracts positive results were always obtained with the extract of 0.5 to 3.0 cubic centimeters of liquor folliculi while the extract of 10 to 60 grams of corpus luteum gave negative results. It will be noted that the

amount of liquor folliculi necessary to cause oestrus changes was much less than the amounts of corpus luteum injected. The animals upon which we tested our corpus luteum extracts were occasionally caused to have an induced oestrus cycle by the use of liquor folliculi to prevent the atrophy due to castration.

In our experiments upon rabbits the corpus luteum extracts gave in no case a positive result. Five tests of our corpora lutea extracts were tried on rabbits. The rabbits were injected with extracts of from 50 to 80 grams of tissue over periods of 4 to 7 days. Very typical results may be seen in the set of litter mates marked 'A'. In this experiment the corpora lutea were clipped, the liquor folliculi was aspirated from the follicles and extracts were made of corpora lutea liquor folliculi and the remaining shucked ovaries. Equal amounts of extracted tissue (77 grams) were injected over a period of 7 days. The results in each case may be seen in Figure 1. The uterus marked 857 is from the rabbit which had the corpus luteum injection and it can easily be seen that it is smaller than the control 856. Number 858 received extract of liquor folliculi and number 859 received the extract of the shucked ovaries. Number 854 received injections of a water soluble commercial extract and no increase in size is noted.

We were anxious to see if the corpus luteum extract had any inhibitory effect on the action of the extract of liquor folliculi. Three litter mates 'C' were used. Into each rabbit the extract of 15 grams of corpora lutea was injected into another the extract of 75 grams of liquor folliculi and into the third animal 150 grams of a mixture of equal parts of corpora lutea and liquor folliculi. If our corpus luteum extract had any marked inhibiting influence on the liquor folliculi extract we should expect the uterus of the animal which had the two extracts to be smaller than the uterus of the rabbit which had only the liquor folliculi extract but such was not the case. The uterus of the animal with the two extracts being larger by a very small amount. We can not expect one experiment to prove this point but the result seemed to be of interest.



Fig 1 Showing results of experiment in litter mates A

#### SUMMARY

1 Corpus luteum has been cited as the source of the hormone which produces hyperplasia of the genital tract and some authors claim that extracts made by extracting corpus luteum with lipid solvents are able to cause growth in the genital tract of certain mammals.

2 The amount of care exercised in collecting material is a factor which must be considered in order to be sure of the type of tissue obtained.

3 Using rats and rabbits we were unable to produce any noticeable changes in the genital tract by the injection of the alcohol ether acetone extract of carefully collected corpora lutea from pigs.

4 Pregnancy of the animals from which the corpora lutea were gathered the size consistency or color of the corpora lutea had no effect on the results obtained.

5 We have obtained repeated positive tests with the alcohol, ether acetone extract of liquor folliculi of bog ovaries and in view of this are inclined to believe that the corpus luteum does not secrete the hormone which produces hyperplasia of the uterus and vagina.

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## RETROPOSITION OF THE UTERUS, A PRESENT DAY ESTIMATE

By JOHN F. McGRATH, M.D., F.A.C.S., NEW YORK CITY

THERE is perhaps no subject in the whole field of gynecology concerning which more divergence of opinion has been expressed than that of uterine malposition. The significance, prevention and treatment of posterior displacement of the uterus are not adequately understood or properly evaluated by the rank and file of the medical profession. The theme of this paper was suggested by a consideration and studied interpretation of an authoritative editorial from the able pen of Arthur Dean Bevan (2) in the February 1923 issue of SURGERY, GYNECOLOGY AND OBSTETRICS. With reservations we accept the conclusion that the uncomplicated movable retroposed uterus produces no symptoms and that 'the time has arrived when operations done on women for retroposition of the uterus and for this condition alone are unwarranted unnecessary and in defensible.

## SIGNIFICANCE OF RETROPOSITION OF THE UTERUS

Ample statistics have been collected by Stacy (12), Jaschke (8) and others in support of the dictum that retroposition of the uterus *per se* does not produce symptoms and therefore does not require treatment. A concise analysis of this broad subject however demands recognition of the teaching advanced by Thuelhauber (14) in 1895 and confirmed by Baldy (1), Bovee (3), Clark (4), Findley (5) and many others that the so called symptoms of retroposition are not characteristic of the displacement but are indeed quite characteristic of the various complications that are so frequently incidental. Symptoms may vary in direct proportion to the kind and extent of the associated lesions. In general it is possible on careful examination to ascertain the particular pathology causative of gynecological symptoms in each case. Admittedly in an occasional instance symptoms may be due to the mechanical dystocia but there can be no doubt that such is the exception to the general

rule. That the primary displacement can be the cause of pathological sequelae is the consensus of expert gynecological opinion borne out by definite clinical observation.

A study of 1000 consecutive cases of retroposition of the uterus examined in the Clinic of Cornell University Medical College revealed the facts shown in Table I.

TABLE I—RETROPOSITION OF THE UTERUS

Pathology	Single No.	Multiple No.	Total No.	Percent Total
Complicating pathology demonstrable on examination	53	53	816	90
Cervical disease	38	38	721	80
Adnexal disease	10	10	486	54
Adherent retroversion	11	11	61	39
Plastic dystocia, cystocele, prolapsus, etc.	2	2	414	4
Symptomatology				
Leucorrhoea	48	48	668	74
Dysmenorrhoea	67	67	356	42
Backache	32	32	375	41
Menorrhagia	7	7	81	9
Sterility				

Of the 900 married women 214 or 23.7 per cent had never been pregnant.

In 73 of 8 per cent sterility was the chief complaint 686 or 76 per cent had been pregnant.

Before drawing conclusions from these statistics or any similar tabulation we must appreciate that the variety of pathological and symptomatic combinations is infinite. It is apparent that each case must be studied and treated on its merits and there is no rigid rule that can govern the character and proper management of retrodisplacement of the uterus. The outstanding inference is that symptom producing retroposition is most prevalent among women who have been pregnant and that the causative pathology is demonstrable in the great majority of cases. We must assume that retrodisplacement of the uterus is always an anatomical abnormality and it is not logical to insist that such an anomaly is normal for any woman though frequently there may be no symptoms attributable to such displacement.

Retrodisplacement of the uterus may well be divided into two classes the congenital or developmentally defective and the acquired types. The associated symptom producing condition may be similar in both types but there are differentiating details that must be recognized before proper judgment and treatment can be secured.

In the first or smaller group are those types found most frequently in unmarried girls or nulliparous women. This group is more apt to be of the non symptomatic type and for that reason usually not associated with other pathological conditions requiring treatment. As Stacy (12) has shown uncomplicated retroversion occurs in about 20 per cent of unmarried women and there is little difference in the character of menstruation and incidence of symptoms in cases of retroposition and in cases of ante-position of the uterus. The congenital retroposition is quite apt to be a local manifestation of a constitutional muscular and fascial deficiency. A general endocrine dysfunction and a genital insufficiency are frequently observed.

However, the second group the acquired type is the large group that demands intensive study and offers great promise both in the matter of prophylaxis and of permanent cure. This is so because this type comprises by far the larger number of cases of retrodisplacement and because it may be said that the acquired type is always associated with other pelvic conditions and therefore is symptom productive or potentially so. Even when no gross pathology can be demonstrated in careful gynecological examination and when competent orthopedic and neurologic study fails to account for symptoms it is possible to assume the presence of some definite associated lesion. An example of this is frequently seen when the pelvic examination is negative except for mobile retroversion yet the complaint headache or menorrhagia is relieved by a properly applied pessary and the operative findings reveal definite varicocele of one or both broad ligaments and an associated hyperplastic endometritis. Admittedly it is in the apparently uncomplicated mobile displacement that the most careful study and expert judgment must be employed.

# PREVENTION

Little can be done in the prophylaxis of retroposition of congenital origin. General hygiene, diet, proper exercise, care of the bowels, more careful supervision of girls during puberty, with perhaps the occasional exhibition of glandular therapy constitute the conservative palliative management of this condition.

It is fair to assume as Gellhorn (6) has insisted that every acquired retrodisplacement is pathological even if uncomplicated and must produce symptoms sooner or later. In the great majority of cases acquired displacement is preventable by proper treatment following the termination of pregnancy. Any measure directed toward the rapid resolution of traumatic injury, the result of labor will lessen the likelihood of malposition. Frequently, as Baldy (11) and others maintain the related pathology is causative of the displacement. A lacerated cervix or perineum is often the cause of the subinvolution and consequent retroposition. Even in easy spontaneous delivery it must be assumed that definite damage to the structural anatomy of the birth passage is incurred. Overstretching and solution of continuity of the muscular and fascial layers may be submucous and yet often of greater etiological significance than the evident laceration through the mucosa. The ease with which the mucous membrane and fascial slides and assumes another and lower permanent attachment is obvious.

Although Howard Kelly in a recent review of Thirty Years of Gynecology declared that he rarely employed that obsolete instrument the vaginal pessary its sphere today is greater than in those early days when it was used as a curative agent. There is no better method of differential diagnosis than the employment of a well fitting pessary as a try out to determine the ability of maintained reposition of the uterus to relieve the symptoms complained of. If the pessary affords relief one can expect a proper operative restoration to do as much or more. When manual replacement of the uterus is not easily accomplished a proper pessary and postural exercise will often correct an erroneous diagnosis of adherent displacement. Contra

indications to the use of a pessary are easily recognized and the futility of pessary treatment quickly established. As an aid to promotion of complete involution by means of posture and exercises a properly fitting pessary is the most effective means we have for the prevention of posterior displacement of the uterus. The routine insertion of an Albert Smith pessary at an interval after abortion, miscarriage or labor in conjunction with proper post partum care and follow up observation will lessen the incidence of uterine malposition. A pessary should be worn for a period of from 1 to 6 months and local treatment of cervical laceration and disease with the electrocautery may be indicated.

The incidence of retroposition of the uterus following labor is placed by Lynch (10) at 41 per cent and by Paine (11) at 50 per cent. Probably if obstetrical cases were observed post partum over a much more extended period greater prevalence would be noted. It is not unusual to find a fundus uteri in good position at 2 months after delivery and to find it in extreme retroversion at 6 months post partum.

#### TREATMENT

It is rarely necessary to treat retroposition of the congenital type. Marriage and pregnancy activate the genital physiology most favorably in many cases unless the disability is severe radical measures are only infrequently indicated. After competent diagnosis and observation however interference is often attended with excellent results. Rational conservatism demands according to Stoeckel (13) that apparently uncomplicated mobile retrodisplacement of the uterus, when causative of symptomatic complaint be subjected to proper treatment. Recognizing the potential pathology and the predisposition to pelvic morbidity in uncomplicated posterior displacement we find definite indications for palliative measures and even as Grad (7) has maintained prophylactic operation. While sterility may be the only complaint when pregnancy and normal post partum involution occur an absolute and permanent cure may result. As a rule unless the uterus is maintained in good position after labor by a suitable pessary for an extended

period of time recurrence of the displacement takes place. Operative treatment is the proper procedure in very few cases of deficient structural development and even in this small group the likelihood of cure is slight indeed.

If the pessary treatment of the acquired type is instituted early enough cure can reasonably be expected. As a rule when more than one year has elapsed after termination of the causative pregnancy conservative treatment will not effect a cure and yet depending upon the age of the woman and the character of her disability it is often evidence of superior judgment to defer operative treatment if transient relief can be obtained by such palliative measures. Not infrequently one may observe pregnancy supervene, and with the aid of continued pessary support for perhaps several months efficient obstetrical care post partum may be rewarded by permanent cure of the displacement. In this condition as in all others, systemic hygiene and constitutional improvement will enhance all local treatment.

When however, the condition has progressed to the stage of definite anatomical impairment and structural atrophy, no amount of postural or calisthenic treatment will suffice and operative treatment is imperative. Of the hundred or more operations devised for the cure of retroposition of the uterus it is perhaps fair to say that each and every one may in a properly selected case effect an anatomical or a symptomatic cure or both. While a standardized technique will never be recognized as applicable to all cases of retroposition of the uterus it is time that almost all of the known methods were thrown into the discard and that the few best ones be approved.

As Bevan (2) has well said 'no surgeon has a right to perform an operation for fixation of the uterus that carries with it the danger of intestinal strangulation. There can be no doubt but that the number of such disasters as he has reported is on the increase due to the greater frequency of popular and easy methods of uterine suspension.' Every operation that bridges the abdominal cavity as in ventral fixation Olshausen or Gilliam methods should be abandoned. It must be admitted that gut strangulation is a likely possibility in every operation of such type.

The operation of greatest assured value is that of the modified Simpson or Montgomery subperitoneal technique which restores the uterus to its normal position with a minimum departure from the normal anatomical relations and physiological functions. Obviously any operative technique to be competent must include efficient care of all the associated pathology and contributing factors. A relaxed pelvic floor must be restored, a diseased cervix properly repaired, adnexal disease removed. Descensus of the bladder ranging from slight relaxation of the anterior vaginal wall to marked cystocele is so frequently present as to warrant the routine elevation of the bladder upon the anterior uterine surface in the manner described by Keefe (9). In extreme cases it is quite feasible to free the bladder from its cervical and vaginal attachment and perform an internal 'interposition' operation with sterilization if in the child bearing period, and the round ligament shortening of the Simpson-Montgomery method. Occasionally it is well to shorten the sacro-uterine ligaments or even obliterate the pouch of Douglas. Failure to account properly for any defect may jeopardize the success of the entire operative effort. It is fair to say that the retroposed uterus can be restored to its normal position by this Simpson-Montgomery technique modified to suit with a minimum operative risk and with a maximum expectation of permanent cure. If properly done, no contra-indication to future pregnancy exists, no dystocia occurs, nor is recurrence after subsequent labor likely if competent post partum observation and care be provided.

There are cases in which the round ligaments are so deficient as to render the Simpson-Montgomery technique inadvisable and at other times it is anatomically impossible to bring the fundus forward in this manner. Frequently there is associated in these circumstances a prolapse of both adnexa with

marked varicose veins of both broad ligaments and the operation of choice is that of the Baldy-Webster type which indeed is the most efficient means of providing adnexal elevation and support.

#### CONCLUSIONS

1. Congenital retroposition is rarely symptom productive and therefore it seldom requires treatment.
2. Symptom productive retroposition of the uterus of the acquired type is most common among women who have been pregnant.
3. Symptom productive retroposition will show on careful examination associated conditions and the diagnosis will quite certainly be confirmed at operation.
4. More efficient and extended post partum observation and care will greatly lessen the incidence of acquired retroposition.
5. The vaginal pessary when properly used is an instrument of undoubted value and should be more frequently used to promote proper post partum involution.
6. Any operation that carries with it the risk of intestinal obstruction or uterine dystocia should be condemned.
7. The Simpson-Montgomery technique with proper care of associated defects offers the best prospect of cure.
8. In a few selected cases the Baldy-Webster technique is superior.

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# A COMPARATIVE STUDY OF RADIATION AND SURGICAL TREATMENT FOR FIBROMYOMATA OF THE UTERUS<sup>1</sup>

BY FRANCES A. FORD, M.D., ROCHESTER, MINNESOTA  
 Section of Obstetrics and Gynecology, The Mayo Clinic

A COMPARATIVE study of representative groups of patients treated at the Mayo Clinic for fibromyomata of the uterus either by operation or by radiation has been undertaken to determine the late results of these methods of treatment and the incidence of complications. This has afforded at the same time an opportunity to review certain clinical phases of the presence of fibromyomata in relation to the symptoms and the general health of the patient. The 250 patients operated on represent those registering consecutively during 1918 for whom a diagnosis of fibromyomata of the uterus was made and who were referred for surgical treatment while the 344 patients treated by radiation include a group from each year (1918 to July 1924) because of the gradually changing dosage and technique of radiotherapy during that time.

Ewing asserts that 50 per cent of all women more than 50 and 20 per cent of those more than 25 have fibromyomata. The presence of demonstrable tumors is rare during puberty although Leopold believes that the rudiments of them may be found in the uterus of children. The average age of the 250 patients at the time they presented themselves at the Clinic for examination and treatment was 42.9 years. The average age of the 245 patients treated by radium was 44.4 years, of the 65 treated by radium and roentgen rays 46.3 years, and of those treated by roentgen rays alone 47.1 years. While the presence of tumors had often been detected many years before the menopause the symptoms apparently had not been troublesome until the patient approached that period.

The fact that the average age of the surgical patients is lower than that in the other groups might be construed as an attempt to apply to younger persons the treatment which is best adapted to conserving reproductive function. Surgical myomectomy is generally regarded

as the method of treatment most likely to attain this object; there are many instances in the literature in support of this belief. For example, Gellhorn cites a case in which after four large interstitial fibromyomata had been excised, the patient went to a normal full term pregnancy. However, pregnancy with the birth of a normal child has also been observed following radiotherapy. Castano, in reporting 250 cases of fibromyomata treated by radiation, states that three of the patients became pregnant following treatment. Of 1,013 patients treated with radium at the Mayo Clinic since 1915, Stacy found that 4 women had each had a living child, 3 others had given birth to dead fetuses, 1 had had two miscarriages, and 1 was pregnant at the time of her report. In a series of 741 myomectomies reviewed by Stacy, 33 women later had a viable child, and 11 women 2 or more children. Schiller reports the history of a woman aged 43 who had never been pregnant. Premature menopause was induced by roentgen rays because of excessive bleeding. Definite fibromyomata were present in the uterus. Six months after the treatment menstruation reappeared once after which the patient became pregnant and delivered a full term baby which was normal at the last observation, 18 months later.

Of the cases reviewed in the present study, 3 in the surgical group were under 30 years, but in each case at operation myomectomy proved to be impracticable. Five of the patients treated by radiation were under 30. Three of the 5 had normal pregnancies following radium treatment, all of these being included among the cases reported by Stacy. Three were operated on because of a return of symptoms while the fifth has not been heard from. Twenty-seven per cent of the patients treated surgically and 22 per cent of those treated by radiation were between 30 and 40. Thirty-eight were past the menopause, 19 in



TABLE I—CHIEF COMPLAINTS AND OBVIOUS SIGNS AT THE TIME OF ADMISSION

Symptoms and signs	Treated by radiation		Treated by operation	
	Cases	Percent	Cases	Percent
Profuse menstruation	95	28.0	63	25.0
Irregular bleeding	63	18.0	22	8.8
Pelvic pain on pressure	11	3.0	13	5.2
Lower abdominal pain	36	10.0	38	15.2
Cystitis or urinary symptoms	8	2.0	3	1.0
Dysmenorrhea	8	2.0	16	6.5
Prolapsed uterus	2	0.6		
Backache	5	1.5		
Vaginal discharge	7	2.0		
Frequent miscarriages	1	0.3		
Pseudocyesis	1	0.3		
Weakness and fatigue	12	3.4	12	4.8
Presence of tumor noted	20	6.0	57	22.0
Symptoms unrelated	97	29.0	59	23.6
Tumor found in routine examination without symptoms	1	(30.5)	3	(12.6)

each major group the average lapse of time since the menopause was 3.8 years. One patient aged 76 who had passed through the normal menopause at 52 had first noted the pelvic tumor 4 years before her treatment at the Mayo Clinic and during these 4 years the growth had been quite rapid. Instances of this type discredit the hypothesis that the growth of fibromyomata is stimulated by an ovarian hormone or interaction of ovarian and uterine tissues. Bland Sutton says that fibromyomata arise in the uterus only during menstrual life, that after the cessation of menstruation they cease to grow and some diminish in size. Although the growths may have been present during menstrual life the following 2 cases cited by Trostler indicate that the excitation to growth may occur long after the ovaries have ceased to function.

A patient for whom a bilateral salpingectomy and oophorectomy had been performed at the age of 33 presented 3 years later a large smooth fibromyomatous uterus extending to within 7.5 centimeters of the umbilicus. The second patient, both of whose ovaries had been removed at the age of 35, had a fibromyomatous uterus extending to the umbilicus when she was 40.

Gibson observed the appearance and growth of a uterine myoma about 15 centimeters in diameter within 7 months after the removal of both ovaries. That the removal of ovarian

TABLE II—TYPE OF MENSTRUATION

Symptoms and signs	Treated by radiation		Treated by operation	
	Cases	Percent	Cases	Percent
Profuse and prolonged	183	53.0	92	35.0
Irregular	123	35.7	47	18.3
Scanty	13	3.8	11	4.4
Regular moderate	51	14.8	82	32.3
Continuous	11	3.0		
Painful	82	23.8	82	32.3
Past menopause with return of bleeding	11	3.0	14	5.6
Pelvic pain	67	19.0	73	29.0
Total	344		52	

hormones alone is not sufficient to reduce a fibromyomatous mass is indicated by the case reported by Gellihorn of a patient aged 64 who although bilateral oophorectomy had been performed as treatment for fibromyomatous tumors when she was 30 presented a mass still about 18 centimeters in diameter after the intervening 34 years.

The theory of ovarian stimulation of fibromyomatous growths has been the basis of the school of radiological technique commonly described as the German school which seeks to suppress ovarian function in the hope that the resultant physiological reactions will reduce the uterine tumor. Opponents of this method contend that the roentgen rays affect directly the neoplastic elements of the tumor and that the successful results with the German method of treatment are due to the inclusion of a part or all of the tumor in the fields of treatment (Table I).

Increased or prolonged menstrual flow is obviously the most common indication of the presence of fibromyomatous growths. It is well known that the fibromyomata may be symptomless for many years (Table II).

Ewing mentions sterility as one of the possible causes of fibromyomatous tumors. Among the large number of patients having fibromyomata Young found sterility in 35 per cent while for all women sterility was found in about 10 per cent. It is more generally believed that the fibromyomata are a cause of sterility by mechanical irritation or obstruction rather than a result of it (Table III).

It has heretofore been considered that fibromyomata presenting a mass larger than

TABLE III—FECUNDITY OF PATIENTS WITH FIBROMYOMATOUS TUMORS

	Treated by radiation		Treated by periton	
	Cases	Percent	Cases	Percent
Married	302		214	
No pregnancies	56	18.0	66	30.0
Miscarriages only	20	6.6	26	12.0
Nonsterile	246		143	
Average miscarriages	0.75		0.8	
With viable child	226		122	
Average children each patient	3.1		2.6	

TABLE IV—SIZE OF TUMORS<sup>1</sup>

Tumor	Total cases	Grade 1		Grade 2		Grade 3		Grade 4	
		Cases	Percent	Cases	Percent	Cases	Percent	Cases	Percent
X rays	30	6	0.0	14	46.0	10	33.0		
Radium	224	17	7.0	44	20.0	3	1.3		
X rays and radium	64	23	36.0	32	50.0	9	14.0		
Unoperated	140	61	29.0	36	25.0	70	30.0	14	5.8

1. few instances cured; 1 died with grade 1; 1 tumor was

TABLE V—THE FREQUENCY AND TYPE OF PREVIOUS TREATMENT FOR OPERATIVE CASES

Treatment given	Cases	Tumor status	
		By radiation	By periton
Myomectomy	25	15	10
Unilateral oophorectomy	27	14	13
Partial bilateral oophorectomy	1		1
Cysts of ovary	10	4	6
Drainage of pelvic abscess	5	1	4
Dilatation and curettage	54	42	12
Polyps from cervix	5	4	1
Tumors from cervix (1 dermoid others not specified)	9	2	7
Trachelorrhaphy	3	3	2
Internal suspension of uterus	10	17	2
Cauterization of cervix	1	1	
Hysterotomy	1	1	
Radium (2 had 2 applications)	3	3	
X ray	1	1	

that of a 4 months pregnancy are best cared for surgically. Recent reports by prominent radiotherapists indicate a tendency to disregard this limit. Beclere in 1922 in a review of 300 new cases of fibromyomata treated by roentgen rays cautions against treatment of an incarcerated pelvic tumor but includes among cases successfully treated those with tumors extending 30 to 34 centimeters above the symphysis pubis.

In the present series the tumors have been divided into 4 grades according to extent. Grade 1 pelvic tumors. Grade 2 abdominal pelvic tumors up to one half the distance from the symphysis to the umbilicus. Grade 3 tumors extending half way to the level of the umbilicus and Grade 4 all tumors above this level (Tables IV and V).

From the pathological report following operation note was made not only of the percentage of error in diagnosis but also of the incidence of any condition which might have caused complications had that patient been treated by radiation. Of the 250 patients operated on 71 presented multiple fibromyomata and 29 single fibromyomata with out any pelvic complications determined by the surgeon or by the pathologist in the examination of the specimen. In 55 cases the tubes and ovaries were definitely described as normal. In 95 cases (38 per cent) however chronic pelvic inflammation was found although it had not been indicated by physical findings or history. In 10 cases tubo ovarian abscesses were present. There is a general belief that the application of radium or the roentgen ray to inflammatory lesions is likely to cause an exacerbation. Presumably 40 per

cent of the cases treated by roentgen ray or radium would show chronic pelvic inflammation if explored while as indicated in Tables VII to X an active inflammatory reaction to radium or roentgen ray is relatively rare. Beclere has never encountered such a reaction to roentgenologic treatment although it occasionally follows the application of radium.

The percentage of errors in diagnosis is likewise noteworthy on the assumption that one might encounter the same degree of error in a similar group of patients treated by radiation. Among the conditions which may be so listed in the surgical group were 11 cases of unsuspected adenomyomata, 4 of carcinoma of the ovary and 1 of sarcoma of the uterus. The question of degeneration of fibromyomata is particularly interesting in this regard. In this series there were 31 fibromyomata described by the pathologist as degenerating, 6 being calcareous, 5 very cellular, 4 necrotic, 2 xanthomatous, 2 hemorrhagic, 2 cystic while 8 were described as degenerating.

TABLE VI—COMPUTATION OF THE POSTOPERATIVE RESULTS WITH THE AVERAGE PERIOD OF CONVALESCENCE

Operation	Cases	Effect on menstruation				Symptoms of menopause				Perineal surgery	Health improved		Average
		Cases	Normal	Delayed	Suppressed	N	M	Mod	Severe		Cases	Per cent	
Subtotal abdominal hysterectomy with oophorectomy	56	50	6	—	—	0	0	14	0	1	47	84	6.1
Iliotomectomy with excision of ovary	64	54	3	—	—	5	7	7	8	—	5	8	4.5
Hysterectomy with excision of both ovaries	30	5	—	5	—	1	—	4	—	7	5	16	8

The inability to distinguish definitely from the history or physical findings between a degenerating fibromyoma and a fibromyoma with superimposed malignant disease or associated adnexal malignant disease constitutes the chief objection to the use of radiation for such tumors. It is undoubtedly a wise precaution for every patient treated by radiation to have a preliminary curettage. This seems imperative with a history of metrorrhagia or increased vaginal discharge. Even curettage unless done with extreme care may miss a small malignant lesion. Any question of adnexal attachment or uncertainty about disease in the adnexa should indicate an operation if the general health of the patient permits.

Masson refers to the difficulty in distinguishing simple degenerating or septic fibromyomata and polyps from true sarcomata not only in gross specimens but even after microscopic study. He points out that although sarcomata are occasionally found in the uterine wall and in the cervix they are more common in pre-existing fibromyomata. In 4,322 patients operated on at the Mayo Clinic from 1910 to 1921 for fibromyomata he found sarcomatous change in 44 (1 per cent). Bland Sutton believes such tumors to be malignant from their onset. Ewing deplors the tendency of gynecologists to search through all areas of benign tumors and to regard any variations in structure as sarcomatous change. He has found the ordinary tumors to vary in structure in different persons and probably at different age periods. Such changes may not be progressive. He himself has found only 3 malignant uterine fibromyomata with general metastasis and 2

with local recurrences in an experience extending over 20 years. Winter did not discover malignant disease among 751 patients and concludes that malignant degeneration of fibromyomata must be extremely rare. Williams reports a case in which 4 polypi were removed from the uterus in a period of 5 years; the first was considered benign, the second and third were diagnosed small round cell sarcoma, and the fourth seemed to be a benign tumor. After a period of 3 years there was no sign of recurrence. Bécclere states that sarcomatous disease of uterine fibromyomata before and after the menopause is observed in less than 2 per cent of the cases, and from a clinical standpoint it is suggested by rapid growth, unusual softness on palpation, and general symptoms of cachexia. Frequent observation of the cervix during a course of treatment is advised by Bécclere to detect protruding polypi which are generally considered suggestive of malignancy. In 1918 Wagner reported a case in which he believes sarcoma developed as a result of roentgenological treatment for fibromyoma. The consensus of opinion at the present time is that such a tumor was sarcomatous from the beginning and roentgenological treatment simply caused necrosis of the growth and acute symptoms. Seitz and Wintz indeed recommend the use of radium and roentgen rays in all cases of doubtful sarcomatous change since the operative results are known to be poor while a sarcomatous growth is often checked by adequate radiation. Bland Sutton found the average duration of life following operation for myosarcoma of the uterus to be less than 2 years and the operation itself is attended with unusual risk. Radiation as the treatment

TABLE VII—RESULTS OF RADIUM TREATMENT FOR FIBROMYOMATA

Dosage	Cases	Time d	Effect on m e n t					Effect on skin					Symptoms of menopause					Health		Average length of follow-up in months	Later treatment	
			Cased	R to rd	N effect	R d d m n	Had passed m e n	C on t r o l	P r i n t c l a	L e a d a g	P l a n d	N e t l a d	N e a	N e l d	M e d i	S e e	N e t r e d	Impr o v e d	U n i m p r o v e d		P e r d u r a t i o n	O p e r a t i o n
Group 1 to 400 mg h o u r s	56	55	77	0	2	1	1	3	4	16	7	2			0	3	5	3	13	36	18	12
Gr p 2 to 600 mg h o u r s	15	35	78	17	2		3	0	10	1	4	88	3	70	46	11	37	87	5	30	0	21
Group 3 to 800 mg h o u r s	37	0	6	3				6	3	3		55	2		18		3	18	3	33	2	3
G r p 4 Ov r 800 mg hours	2		1	1											1		1	1	1	60		

of choice for any sarcomatous condition in the uterus was endorsed by the German Congress of Gynecologists of 1900.

Of the 250 patients operated on for fibromyomata replies to questionnaires have been received during the last year from 158. 21 others who did not reply had reported or had been seen at the clinic later than 1 year following the operation. For 71 patients no report of their late clinical result was available (Table VI). The results in hysterectomy with bilateral or unilateral oophorectomy have been differentiated chiefly to note whether the severity of the vascular phenomena associated with the menopause was roughly proportional to the amount of ovarian tissue removed. Apparently this is not a simple relationship but is largely influenced by other factors notably the nervous temperament of the patient. As in all subjective symptomatology it is difficult to evaluate the report of patients on this score as intense discomfort for one patient will be described as a mild reaction by a more placid person. However, the fact that 2 patients still in active menstrual life had no hot flashes following double oophorectomy while 9 patients complained of severe reaction following removal of the uterus only indicates the variation in the replies.

Such symptoms as the persistence of vaginal discharge are of course not attributed to any deficiency or failure in the treatment of fibromyomata. I have endeavored however to note all of the pelvic symptoms which might necessitate later treatment by radiation or operation. Three patients were sufficiently

annoyed by persistent vaginal discharge and irregular bleeding to require later amputation of the cervix. One reported extreme discomfort because of prolapse of the cervix.

Melson found that of 2350 cases of subtotal abdominal hysterectomy for fibromyomata in only 19 was carcinoma known to have developed in the stump of the cervix, a percentage of 0.8. Two of the patients in the present series had a small growth removed from the cervix later and one of these now has a recurring growth the removal of which is advised by her home physician. Another patient has a cystic tumor of the vaginal orifice. Increased pelvic pain led to the diagnosis of pelvic abscesses in 2 cases; these were drained in both instances. The abdominal wound opened in 1 case after the return of the patient to her home while in 2 patients hernias developed at the site of operation. In 1 case complicated by bilateral tubo-ovarian abscess a vaginal fistula developed probably at the site of drainage while in one carcinomatous case of bilateral cystadenoma a rectovaginal and vesicovaginal fistula developed with the recurrence of the disease. There is no evidence of a recurrence in the case reported sarcomatous.

Among the immediate surgical accidents was the death of one patient from pulmonary embolism on the eighth day and of a second patient whose primary operation was for ruptured appendix from peritonitis on the twelfth day, surgical mortality of 0.8 per cent resulting.

A composite survey of results from radiation would be of little value, since the dosage and

TABLE VIII—OPERATIONS SUBSEQUENT TO RADIUM TREATMENT (GROUP 1 TABLE VII)

Operation	Time since radium treatment	Cause	Pathological condition	Remarks
Dilatation and curettage		Retention of clots if not evacuated	Pyometra	
First operation cysto-fistulotomy Second operation hysteropexy		Free flow	Nervous fibromyomata second operation	
Myometomy		Retention of fibrin clots		Patient later pregnant.
Subtotal hysterectomy	5	Continued bleeding	Subacute pelvic peritonitis. Tuberculous focus. (Fright vary)	
Subtotal hysterectomy	5 or 6 months	Continued mild dysmenorrhea		Discharge thereafter
Subtotal hysterectomy	5 months	Irregular bleeding	Multiple fibromyomata	
Abdominal hysterectomy	8 months	Pelvic fibroids	Multiple fibromyomata. Retention of clots.	
Abdominal hysterectomy	5	Irregular bleeding	Retention of clots. Multiple fibromyomata.	No symptoms after first radium treatment. After 3 years, the irregular bleeding resumed. Radium and X-rays no effect.
Abdominal hysterectomy	5	Gonorrhea—leucorrhea	Multiple	Retention of clots with leucorrhea
Retrograde menstruation with blood	5	Pain?		Patient had had repeated radiation. Uterine involution
Unilateral	4.5	Retention of fibrin clots		Patient had had normal pregnancy for 1 year.
Unilateral	?	Continued bleeding		

technique used during the period covered (1918 to July, 1924) has been greatly modified. One is accustomed to see in the literature general statements with regard to the result of radiotherapy or an arbitrary expression of preference for either radium or roentgen rays without sufficient data to enable the reader to test the conclusions. Of the 344 patients treated by radiation recent replies have been received from 214 and reports from 91 later than 1 year after treatment making a total of reports on 305 cases. Unfortunately not all of the information requested was furnished by each patient; the percentages in the tables indicate only the positively ascertained results and will not always total 100.

The selection of either radium or roentgen rays as the therapeutic agent and the amount of each to be given depend largely on the situation and size of the fibromyoma. A small submucous fibromyoma responds usually to a small dose of radium; a larger tumor or a pedunculated tumor should receive a combination of radium and roentgen rays or roentgen rays alone. For young women who suffer chiefly from excessive menstruation with small

fibromyomata an effort is often made to treat with relatively small doses to maintain if possible a normal menstruation and the function of reproduction. The uncertainty of results in such instances is always carefully explained to the patient before the treatment is given (Table VII).

In Group 1 of the 53 patients reporting 18 (34 per cent) required repeated radiation. Six patients complained of an irritative vaginal discharge following the treatment. Twelve patients were subsequently operated on (Table VIII).

Besides the cases mentioned in Table VIII 1 patient developed a pelvic malignant disease symptoms occurring 3 years after the radium treatment. One patient also had a normal full term pregnancy following which menstruation again became profuse and the initial dose of radium (350 milligram hours) was repeated. The patient died 1 week later apparently from acute nephritis. This was the only death among the patients treated by radiation for nonmalignant pelvic diseases.

In Group 2 that is those receiving 500 to 999 milligram hours of radium further radi-

TABLE IX.—OPERATIONS SUBSEQUENT TO RADIUM TREATMENT (GROUP 2 TABLE VII)

Operation	Time since radium treatment	Cause	Pathological diagnosis
Expi. abdo.	18	Irr. regul. bleeding	Malignant disease
Expi. abdo.	3	Irr. regul. bleeding	Carcinoma of cervix
Ca. tracheostomy	12	Irr. regul. bleeding	The most this pregnancy later term stage of the fibromyoma
Curettag.	Unrecorded	Abortion	Uterine mass diagnosed as inflammation (adeno)
Hyst. ectomy	0	Tumor not treated	Adenomyoma of uterus
Hyst. ectomy	8	Tumor not treated	Multiple fibromyomata (absc. out)
Hysterectomy	0	Excess flowing	Multiple fibromyomata (absc. out)
Hysterectomy	15	Excess flowing	Multiple fibromyomata (absc. out)
Hyst. ectomy	4	Excess flowing	Multiple fibromyomata (absc. out)
Hyst. ectomy	18	Irr. regul. bleeding	Multiple fibromyomata
Hyst. ectomy	18	Irr. regul. bleeding	Multiple fibromyomata
Hyst. ectomy	36	Irr. regul. bleeding	Multiple fibromyomata
Hyst. ectomy	5 yr 75	Pain	Dyspareunia both pre and post treatment elsewhere
Hysterectomy	1 yr	Pain	Carcinoma of uterus
Hyst. ectomy	15	Symptoms unrelieved	Extensive adenocarcinoma of uterus with secondary involvement of bladder
Hyst. ectomy	30	Symptoms unrelieved	Acute appendicitis
Hyst. ectomy	4 yr 75	Tumor not reduced	Multiple fibromyomata (absc. out)
Hyst. ectomy and myomectomy	11		Left pyosalpinx due to long fibromyomata
Hyst. ectomy with salpingectomy and oophorectomy	1	Acute pelvic inflammation	Extensive adenocarcinoma of uterus with secondary involvement of bladder
Hyst. ectomy with salpingectomy and oophorectomy	5	Acute pelvic inflammation	

ation was given in 20 instances (15 per cent). Twenty one patients were operated on (Table IX).

One patient whose profuse bleeding was not controlled died a few months after her treatment. Three patients have been advised to return for observation each having reported symptoms suggestive of possible malignant change. *Beclere's belief* that a return of menstrual flow not accompanied by prompt cessation of the vascular phenomenon of the menopause is probably due to malignant disease of the pelvic organs may prove helpful in the differential diagnosis in such cases.

One patient in this group illustrates an unusual continuance of ovarian activity. When she was first seen at the age of 61 the menstrual periods were irregular and profuse. On bimanual examination a large hard irregular uterus was palpated. Six hundred mil-

ligram hours of radium were applied in April 1919. This was followed by cessation of menstruation for 8 months. In April 1921, she was given 1000 milligram hours of radium and menstruation ceased for four months. Since August 1921, menstruation has been regular and profuse. The patient is in good health except for periods of weakness due to excessive flow.

In Group 3 patients receiving from 1000 to 2000 milligram hours of radium only 2 are known to have received further radiation. Two were operated on one 5 months after treatment because of dysuria for which the pressure of the fibromyoma on the bladder was responsible the second according to her local physician's report at her own request, 6 months after treatment in order to prevent later complications. The fibromyoma was apparently responding to treatment satis-

TABLE X.—RESULTS OF ROENTGEN RAY TREATMENT

Type of roentgen ray	Case	Treated	Co-secting				Effect on menstruation		Effect on tumor				Symptoms of menopause				Health	Operation	Comments
			1	2	3	4	Control	Relieved	Complete relief	Partial relief	Unchanged	Enlarged	Not treated	Not relieved	Not relieved	Not relieved			
135 kV. It	3	0	3	4	1	1	6	3	4	3	3	2	1	3	3	3	1		Usually temporary relief
180 kV. It	22	17	1				10	7	3	3	4	6	1	5	4	6	1	divided	no th

factorily at the time of operation. Two patients reported increased pelvic pain following the treatment. One patient in whose case the diagnosis of benign uterine tumor was somewhat questionable from the first but who because of obesity was considered a Grade 4 risk for operation developed a very definite carcinoma of the fundus 5 years after her first treatment and 2 years after the last application of radium. There had been a foul irritating vaginal discharge only partially controlled by radiation. Undoubtedly the uterus should have been curetted or extensively radiated at the first in view of the possible presence of malignant disease.

Of the patients receiving over 2,000 milligram hours of radium, one had had previous roentgenological treatment for fibromyoma. On admission there was a marked degree of radiodermatitis over the anterior abdominal wall with an area of ulceration which when excised proved to contain epithelioma. Radium was applied for the reduction of the tumor. Three years later the patient returned with extensive pelvic carcinoma.

It is difficult to indicate satisfactorily the dosage of roentgen rays because of the multiple factors which may alter the resulting dose. In general the earlier patients (1918) were treated through several small fields (2.5 centimeters in diameter) over the symphysis pubis. Later the fields were enlarged, two being placed anteriorly to cover the lower abdomen and pelvis with one or two corresponding fields posteriorly. A typical setting may be indicated by the factors: 135 kilovolt peak tension, 5 milliamperes current, 6 millimeter aluminum filter, 40 centimeter skin focal distance, 40 minutes exposure to each

area. Occasionally an 0.5 millimeter copper filter was used with a corresponding increase in time of exposure. Since June 1923 a number of patients have been treated with rays produced at a tension of from 180 to 200 kilovolts. A more severe systemic reaction to the more penetrating rays was anticipated but has not been encountered. In fact the period of convalescence mentioned by the patients in this group has been actually shorter (Table X). There have been several instances of a more or less troublesome diarrhoea continuing in the most severe cases for 3 weeks. Three of the earlier patients developed an annoying first degree radiodermatitis; exposure has been reduced sufficiently to avoid this in later cases. With this voltage the tumor is undoubtedly more promptly reduced. The patients treated with roentgen rays of moderate voltage have been selected from those for whom repeated observations and treatment would not be inconvenient.

In Group 1, 1 patient whose uterine tumor had been satisfactorily reduced reports an operation 2 years later for a small growth near the bladder. Its nature was not reported.

Among those treated with roentgen rays of higher voltage, 1 patient who suffered particularly from pressure of masses on the bladder was unrelieved and operation 1 year later showed a calcareous fibromyomatous mass impacted in dense adhesion. This patient should clearly have been refused radiation. The tumor had been present 12 years and was described as feeling unusually dense. In a second case with a lobulated fibromyomatous mass extending to the umbilicus the central mass was satisfactorily reduced while the lateral portions were enlarged in this case operation has

TABLE VI—RESULTS OF TREATMENT WITH RADIUM AND ROENTGEN RAYS (65 PATIENTS)

[illegible]

been advised I agree with Beclere that an adnexal mass not responding promptly to radiation should be regarded as probable malignant disease of the ovary.

The treatment of fibromyomata with roentgen rays is particularly free from serious complications. In no case has there been an inflammatory pelvic reaction. One patient with a history of recurring acute pelvic inflammations was treated without reaction. Three years later her admission for treatment of acute pelvic inflammation demonstrated the potential activity of the focus. No deaths from the use of roentgen rays have as yet been reported although the number of cases so treated is constantly increasing. Bickel reports with his technique (which would correspond most closely to the Mayo Clinic 135 kilovolt setting) favorable results in the arrest of excessive menstruation in 98 per cent of cases and complete reduction of tumors in 24 per cent.

The two operations noted in the second division of Table VI were due to failure to reduce the tumor and in each instance a benign growth was found. In the third division however the tumors operated on were definitely malignant. Two patients offered serious surgical risk on account of obesity and exsanguination from profuse hæmorrhage. One was operated on 4 months after the radiation treatment and extensive carcinoma of the body of the uterus and multiple fibromyomata were found. The second patient was explored elsewhere 8 months after her treatment and inoperable malignant neoplasm

found. In the third case the size of the tumor remained satisfactorily reduced for 3 years after 2 courses of radium and roentgen rays. The tumor then enlarged rapidly. The patient was operated on elsewhere and a portion of the pelvic mass removed. The condition was reported to be malignant. One patient suffered from a radiodermatitis from too frequent courses of roentgen rays. Areas of telangiectasis appeared over the abdomen and for a period of 2 years small areas occasionally showed ulceration but they eventually healed.

Among all the groups the period of convalescence is only roughly indicative of the degree of reaction. Patients who report a convalescence of several years following an application of less than 500 milligram hours of radium have undoubtedly confused other causes of poor general health with the particular inconvenience caused by the treatment. Many patients in all groups found that they were able to continue their usual activities without interruption.

## CONCLUSIONS

In these unselected cases of fibromyomata of the uterus treated by operation and by radiotherapy a relatively high percentage of the latter group has been found to require further treatment either repeated radiation (18 per cent) or operation (13.7 per cent) as compared with 4 per cent of the surgical group who received further treatment. It is true however that more recent cases particularly after roentgenological treatment are showing definitely better results through greater expe-



nience in the dosage required. A study of individual cases shows so many thoroughly satisfactory results with radiotherapy that the discrepancy in the total results must apparently be attributed to injudicious selection of cases or to inadequate dosage. Great care must be exercised to rule out malignant disease at the time of radiation. Curettage should precede treatment in any case with suspicious symptoms. Inflammation while apparently uninfluenced by radiation *per se*, as is shown by the lack of reaction to roentgen rays is undoubtedly occasionally aggravated by the manipulation incident to the application of radium. Unusually hard fibromyomata containing extensive calcium deposits cannot be reduced satisfactorily by radiation; an incarcerated pelvic tumor is undoubtedly best removed surgically because of the inability to exclude adnexal disease. A roentgenogram may occasionally aid in detecting calcium deposits within a tumor.

The need of extreme care in excluding malignant disease is indicated by the fact that in 6 of the patients treated by radiotherapy a well established malignant process appeared within 1 year of the treatment. One other patient has probably malignant disease of the ovary but refuses operation. Two others developed malignant disease within the 4 years after treatment although in 1 case this may be considered a recurrence of the epithelioma in the abdominal wall at the time of radiation. In 4 patients who remained free from symptoms for 3 years following treatment malignant disease appeared. This may not be a higher percentage than that of pelvic malignant disease for all women at their age (1.1 per cent). However it raises the question whether a focus of relatively devitalized tissue with altered blood supply may favor malignant change. I believe that complete subsequent histories should be kept for all patients treated with radium or roentgen rays so that we may have more data relative

to this subject. One death (0.29 per cent) followed the application of a small amount of radium and there were two surgical deaths (0.8 per cent) one of which must be attributed rather to the primary operation than the removal of a ruptured appendix.

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## THE BLOOD CALCIUM IN ECLAMPSIA

BY SAMUEL M. FEINBERG, M.D., CHICAGO  
 Inst. of Medicine, Northwestern University Medical School

AND

ABRAHAM F. LASH, M.D., CHICAGO  
 Instructor in Gynecology, University of Illinois Medical School

**A**N investigation of the blood calcium findings in eclampsia was prompted by the following considerations suggesting a possible etiological relationship between the two. In the first place it has been demonstrated that infantile tetany is associated with a decrease in blood calcium. Because of the clinical similarity of the latter condition and eclampsia it was only natural to expect similar findings here. In the second place it is evident that the mineral metabolism of the maternal organism is enormously increased during pregnancy. This is especially true of calcium in the latter half of pregnancy, at which time a large amount of calcium is taken from the mother for deposition in the fetal bones. Consequently it seemed logical to assume that when the mineral metabolism of the mother is unable to stand this calcium drain a calcium poverty manifesting itself in a hypocalcemia would result, and that this condition possibly had some relation to eclampsia.

Furthermore it is well known that during pregnancy osseous changes take place in the mother, such as softening of the bones and dental decay all of which might be interpreted as evidence of disturbed calcium balance. It is a statistical fact that eclampsia is much more common in twin pregnancies. The increased calcium utilization in this condition would tend further to support the hypothesis that eclampsia may be due to a decrease of calcium in the blood.

## THEORIES OF ECLAMPSIA

The theories of the pathogenesis of eclampsia that have been proposed from time to time are legion and cannot be discussed here nor even enumerated. However for the sake of avoiding confusion it is well to realize that practically all the theories proposed fall

in one or another general group. These theories are that eclampsia may be the result of (1) intoxication of the mother with the products of fetal metabolism (2) of the entrance of the fetal or maternal elements into the maternal circulation (3) of anaphylactic reaction or (4) of the disturbance of maternal metabolism.

There are several theories concerning the pathogenesis of eclampsia that have been advanced in the last few years which have not as yet been cast among the discards. In 1913 McQuarrie (20) showed that in eclampsias there is a greater proportion of incompatibilities between the maternal and fetal blood types than in normal pregnancies. He therefore expressed the opinion that eclampsia may be due to agglutinative changes caused by the incompatible fetal blood gaining entrance to the maternal circulation. It is interesting to note that in 1903 Dienst (3) reported similar findings. Talbot (23) advanced the theory that eclampsia is caused by chronic sepsis especially that due to infected teeth.

It has been repeatedly shown that, although the non-protein nitrogen in the blood is as a rule increased in eclampsia the urea nitrogen is proportionately diminished while the other known nitrogenous elements are practically unaffected. This results in a considerable increase in the undetermined nitrogenous bodies. This finding has led to the expression by several (15, 16, 19) that the etiology of eclampsia may be linked up with these undetermined nitrogenous substances.

The possible association of mineral metabolism with eclampsia has been rather neglected. In 1910 Mitchell (21) expounded the theory that calcium deficiency is the cause of eclampsia. In support of his theory he cited certain theoretical considerations several of which are mentioned in the first part of

this paper. He claims to have obtained satisfactory results in eclampsia by feeding calcium salts. He gave absolutely no laboratory data in support of his views and his suggestion was promptly forgotten.

In 1911 Drennan (4) wrote the following: "Puerperal eclampsia may be caused by a toxæmia the result of a fatty infiltration first and following that a fatty degeneration of the liver cells due to the abstraction by the fetus of the calcium which should normally unite with the neutral fat in these cells to form lipoids whereby it could be removed to its—neutral fat—natural depots in the body."

#### LITERATURE ON CALCIUM

In reviewing the literature on blood calcium one should have in mind the following important facts. The figures given by different authors have not the same significance because some express the findings in terms of milligrams of calcium per 100 cubic centimeters of whole blood, others in terms of plasma and others in terms of serum. Furthermore, the methods of quantitative determinations are not always the same and in many cases are now considered unreliable. In this paper unless otherwise noted the figures refer to milligrams of calcium per 100 cubic centimeters of blood serum.

Normal calcium figures for the adult as determined by Howland and Marriott (6) in 1916 are 9 to 11 milligrams per 100 cubic centimeters of serum. Halverson, Mohler and Bergen (5) give the average for normal men as 10.2 milligrams. Lyman (17) in a series of cases reports an average of 6.1 milligrams per 100 cubic centimeters of whole blood for normal men and 7.1 milligrams for normal women. Working with older methods Jansen (7) reports somewhat higher findings 11.5 to 12.0 milligrams per 100 cubic centimeters of serum.

Calcium figures for normal pregnancies vary somewhat with different authors. Jansen (7) gives 11.5 to 12.0 milligrams for pregnancy and puerperium which is the same as for his normal controls. Krebs (13) reports normal figures for early pregnancy and slightly lowered figures for the latter half of pregnancy. Widdows (24) gives similar findings

to those of Krebs. Many other observers such as de Wesselow (2), Mazzocco (18) and Aymench (r) report no appreciable changes in the blood calcium during pregnancy. Linzenmeier (14) claims that he has found the calcium increased in the latter half of pregnancy.

The literature on the blood calcium in eclampsia is extremely meager. There are many reports (8, 11) on calcium content of the blood in various pathological conditions in which eclampsia is not mentioned. In 1913 Linzenmeier (14) writes that in 5 cases of eclampsia he found no decrease in calcium. Morley (22) in the same year by an indirect method of precipitating with oxalic acid and counting the crystals found a decrease of calcium in pregnancy. He concludes: "From these considerations it is too much to hope or to prophesy that some day the unsettled etiology of the toxæmias of pregnancy may be explained by some disordered calcium economy on the part of the patient."

Again Kehrer (10) elaborating on his earlier work reports findings of calcium deficiency in eclampsia. His figures are based on whole blood determinations. His normal pregnancies gave the following figures: maximum 7.26, minimum 5.79 and average 6.46 milligrams. In a series of 24 cases of antepartum eclampsias his figures are: maximum 8.04, minimum 4.1 and average 5.48. In several cases of postpartum eclampsia his figures are: maximum 8.41, minimum 5.52 and average 6.95. An analysis of these results shows that Kehrer is not justified in his conclusions. In the first place his reports are based on whole blood determinations a procedure which has been repeatedly shown to be unreliable. In the second place although his average figure for antepartum eclampsias is lower than that for normal pregnancy the fact remains that his maximum figure is higher than that for normal pregnancy. Furthermore his postpartum eclampsias show an average of calcium considerably higher than his normal pregnancies. In view of the above it cannot be said that Kehrer's results support his conclusions.

In 1917 Halverson, Mohler, and Bergen (5) in a series of normal and pathological cases,

report 1 case of eclampsia with a finding of 8.5 milligrams per 100 cubic centimeters of serum. Krehbiel (12) in another series of cases, mentions a case of eclampsia with the finding of 4.29 milligrams of calcium per 100 cubic centimeters of serum.

From the above consideration it is evident that either because of faulty technique or failure to present a sufficient number of cases the findings of calcium in the blood serum is as yet an unsettled matter. And it is with that in mind that the following investigation is recorded.

#### TECHNIQUE AND SCOPE OF WORK

The determination of calcium was done according to the method of Kramer and Tisdall. Blood was drawn from the arm and the serum separated. Whenever possible 5 cubic centimeters of serum were used in the determinations. To the serum in a 15 cubic centimeter centrifuge tube was added one half its volume of a 3 per cent solution of ammonium oxalate. This was allowed to stand until the following day. The sides of the tube were then rubbed with a rubber tipped glass rod. The tube was centrifuged at high speed for about 10 minutes; the liquid carefully decanted; distilled water added and centrifuged again. This washing process was repeated three times. To the washed sediment were added 5 cubic centimeters of normal sulphuric acid and the tube kept at a temperature of 75 degrees C. This solution was titrated with a one hundredth normal solution of potassium permanganate. The end point was considered that point at which a faint pink remained over 15 seconds. The calculations to be used are based on the fact that each cubic centimeter of permanganate solution represents 0.2 milligram of calcium.

The blood calcium values of several cases of normal pregnancy were determined all of them shortly before delivery. The results are recorded in Table I.

Twelve cases of pre eclamptic and eclamptic toxemias were examined with the results as shown in Table II.

Several other cases at first considered as eclamptic but later proved to be erroneously diagnosed are reported in Table III.

TABLE I—BLOOD CALCIUM IN NORMAL PREGNANCY

Patient	Diagnosis	Mg. c c m per 100 c c m
M G	Eclampsia	10.69
L M	Pre-eclampsia	10.69
C P	Eclampsia	10.15
P N	Pre-eclampsia	10.89
R Mc	Eclampsia	11.38
C	Pre-eclampsia	12.00
F	Eclampsia	10.80
L B	Pre-eclampsia	11.25
S t	Eclampsia	10.40
N R	Eclampsia	11.12
I P	Eclampsia	10.93
Average		10.94

TABLE II—BLOOD CALCIUM IN PRE ECLAMPSIA AND ECLAMPSIA

Patient	Diagnosis	Mg. c c m per 100 c c m
F R	Eclampsia	10.10
W B	Pre-eclampsia toxos	9.20
E P	Eclampsia	10.00
A E	Pre eclampsia	9.33
M F	Pre eclampsia	10.00
A L	Postpartum eclampsia	10.66
A J	Eclampsia	12.00
W B	Eclampsia	9.60
M C	Postpartum eclampsia	9.71
C A	Postpartum eclampsia	10.40
M H	Intrapartum eclampsia	11.20
N B	Eclampsia	10.12
Average		10.21

TABLE III—BLOOD CALCIUM IN CONDITIONS SIMULATING ECLAMPSIA

Patient	Diagnosis	Mg. calcium per 100 c c m
M C	Lazemia	8.50
A W	Chronic nephritis	9.60
R E	Epilepsy	10.50
N M	Cavernous sinus thrombosis	9.60
Average		9.55

It is evident from the above tabulations that although the calcium figures for eclampsia are somewhat lower than those for normal pregnancy the difference is rather negligible. Furthermore in several cases of pathological conditions simulating eclampsia clinically it can be seen that the calcium figures are lower than those for eclampsia.

Other points of interest that have been observed in the cases of eclampsia here recorded are worthy of mention. A history of possible disturbance in calcium metabolism was inquired into in all these cases. None of them gave any history of delayed dentition or walking. None of them had had any recognizable tetany or rachitis. None of the eclamptic

women had ever suffered any previous pregnancy toxemias

# SUMMARY AND CONCLUSIONS

In a study of the blood calcium level in eclampsics it has been shown that

1 On theoretical grounds a decrease in the blood calcium may be expected in eclampsia

2 The literature on this subject does not definitely clear this point

3 In this research it has been demonstrated that there is no appreciable relation between the blood calcium and eclampsia

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CYSTS OF THE SEMILUNAR CARTILAGES<sup>1</sup>

## REPORT OF TWO CASES OF CYST OF THE EXTERNAL SEMILUNAR CARTILAGE AND ONE CASE OF CYST OF THE INTERNAL SEMILUNAR CARTILAGE

BY NATHANIEL ALLISON MD FACS BOSTON MASSACHUSETTS

AND

DENIS S O'CONNOR MD WATERBURY CONNECTICUT

IN a recent article on cysts of the external semilunar cartilage by M Jean three new cases of this unusual condition were added to the literature making a total of 18 cases reported up to that time. Accompanying the report was a review of all previously reported cases and a careful histological study of two of the specimens. This study was made in an endeavor to throw some light upon the etiology of the condition and to adduce evidence in favor of or against the presence of an endothelial or an epithelial lining in the cysts.

The histological study of the specimens was done by Professor Latulle and Dr Seguy of St Anne's Hospital in Paris. They found the specimens so similar that one description would serve for both of them.

Like all cysts previously reported these were multilocular and located near the external border of the midportion of the external semilunar cartilage. A composite picture of the development of the cyst was constructed by a description of the different stages in the development of the cyst as shown by different portions of the specimens.

The earliest visible evidence of change in the tissue was a localized edema which gave the characteristic staining reaction of degeneration. The tissue then became amorphous followed by a stage in which it seemed fibrillar. Spaces formed between these fibrils and filled up with a nuclear debris. The walls of the cyst showed no epithelial or endothelial lining but what on superficial examination was thought to be an endothelial lining on careful examination proved to be a layer of the cyst contents which had become adherent to the walls of the cyst. There was no evidence of hemorrhage or disease of the blood vessels in the tissues examined. There was an increase in the number of cartilage cells in the diseased tissue.

The French investigators reached the conclusion that the condition under discussion was a pseudocyst due to degeneration of fibro cartilage from unknown cause.

Pebmister (2), in the first 2 cases reported from this country found a lining of mature connective tissue.

Ollerenshaw (4) was the only one to report the finding of an endothelial lining.

At this time we wish to report 2 new cases of cyst of the external semilunar cartilage and one new case of cyst of the internal semilunar cartilage. While in some respects the cyst of the internal cartilage resembles the case reported by Fisher (3) yet this cyst was so much a part of the cartilage that it could not be removed without removing the cartilage and therefore has been classified as a cyst of the cartilage rather than as a cyst between the cartilage and internal lateral ligament as was done by Fisher.

**CASE 1** Y. K. a female 27 years of age came to the Orthopedic Outpatient Department of the Massachusetts General Hospital on December 9, 1924 complaining of pain in the right knee of 1 year's duration and difficulty in walking after resting. She could remember no injury to which to ascribe the condition.

Examination disclosed a localized resilient swelling about the size of an American walnut on the lateral aspect of the right knee in approximately the joint line. It was tender on pressure. The mass was under the external lateral ligament and was evidently adherent to the deep structures upon which it rested. Pain was relieved by flexion of the knee to 80 degrees. Roentgenograms showed a soft tissue shadow at the point corresponding to the location of the tumor mass. The blood Wassermann was negative.

A diagnosis of cyst of the external semilunar cartilage was made the patient admitted to the ward and operated upon on January 8, 1925. A transverse incision was made over the lateral aspect of the knee directly over the tumor mass. When the fibers of the external lateral ligament were separated the tumor pushed through into the opening. The cyst with the semilunar cartilage was removed (Fig. 1).



Fig 1



Fig 2



Fig 4

Fig 1 Actual size drawing of coronal section through semilunar cartilage and cyst of Case 1. Defect in upper margin of drawing represents the principal cyst cavity which was opened to permit in section of the cyst. Smaller cysts can be seen below. Remains of semilunar cartilage on extreme right.

Fig 2 Actual size drawing of coronal section through specimen removed in Case 2. Defect in extreme right represents the principal cyst cavity with numerous smaller cysts to the left. Remains of cartilage on the extreme left.

Fig 4 Actual size drawing of specimen from Case 3 showing the main cyst cavity.

On section the cyst was found to be filled with a mucoid substance tinged with red.

The patient made an uneventful convalescence and was discharged home on January 18 walking with the aid of crutches without pain.

February 18 1925 she was discharged from care. At this time she had no pain was walking without support and had a full range of motion in the knee.

CASE 2 N W a female 30 years of age came to the Orthopedic Outpatient Department of the Massachusetts General Hospital in February 1925 complaining of pain in the left knee of 2 years duration. She ascribed her trouble to an injury which she received in a trolley car collision immediately before the onset. The pain was intermittent at first and gradually became worse. The condition had been diagnosed as rheumatism and had been treated without relief.

Examination disclosed a definite localized resilient tumor mass over the external aspect of the left knee in the joint line and directly above the head of the fibula. The mass about the size of an American walnut was located under the lateral ligament and attached on its deep surface to the structures beneath it. The mass was tender on pressure. Pain was present on complete extension and on flexion to 90 degrees. Patient walked with a slight limp.

A diagnosis of cyst of the external semilunar cartilage was made the patient was admitted to the ward and operated upon on February 25. A vertical incision was made over the site of the tumor mass and when the fibers of the external lateral ligament were separated the tumor pushed up into the incision. It was found to be continuous with the external semilunar cartilage and was removed together with the entire cartilage (Fig 2).

Examination of the cyst showed it to be in the semilunar cartilage multilocular in character and filled with a reddish mucoid substance (Fig 3).

On April 3 1925 the patient was able to walk freely without aid and had a range of motion of 70 degrees from 5 to 75 degrees. No pain or tenderness was present.

CASE 3 P V a male 22 years of age came to the Orthopedic Outpatient Department of the Massachusetts General Hospital in February 1925 complaining of pain in the right knee. He first noticed a lump on the inner aspect of the right knee on arising on the morning of November 9 1924 about 3 months previously. He could recall no injury to which to ascribe the condition. The knee was painful at intervals especially at night. He had cramp-like pains in the calf of the leg and in the front of the thigh. A sharp pain in his knee came on when the leg was rotated. The knee was most painful on complete extension and acute flexion. The most comfortable position was about 85 degrees of flexion of the knee.

Examination showed a definite resilient tumor mass the size of half an English walnut visible and palpable on the inner aspect of the right knee in the joint line and extending downward onto the inner aspect of the tibia. It was covered by the internal lateral ligament and attached on its deep aspect to the structures upon which it rested. It was tender to pressure. The swelling according to the patient was no greater on admission than when first noticed 3 months before. The patient walked with a decided limp. The blood Wassermann was negative.

A diagnosis of cyst of the internal semilunar cartilage was made the patient admitted to the ward and operated upon on February 25 1925. Though a curved transverse incision over the mass the internal lateral ligament was exposed. When the fibers of the lateral ligament were separated the tumor mass pushed through the opening. The cyst seemed to arise from the semilunar cartilage and to have grown down onto the side of the tibia. In order to remove the cyst intact it was necessary to remove the internal semilunar cartilage. This cyst much larger than either of the cysts removed from the external semilunar cartilage was found to be filled with the same kind of reddish mucoid material (Fig 4).

The patient made an uneventful recovery and when discharged from treatment on June 3 1925

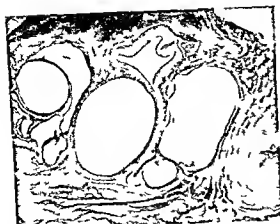


Fig. 3. Photomicrograph of specimen from Case 2 shown in Figure 2.



Fig. 5. Photomicrograph of specimen from Case 3 shown in Figure 4.

the wound had healed nicely, there was no intra-articular or extra-articular swelling, there was a complete range of motion and no abnormal mobility.

The following is a report of the histological examination of the tissues by Dr. S. Burt Wolbach, Professor of Pathology, Harvard Medical School:

There are three specimens submitted from different cases. They all show similar appearances and the same apparent sequences so that one description applies to the three.

The largest cysts, including those of a millimeter in diameter upward, are surrounded by dense fibrous tissue of concentrically arranged cells and intercellular material so that the effect is almost that of a laminated wall. Occasionally on the inner surface of this wall there are flattened nuclei belonging to cells without demonstrable cytoplasm. The contention that these cells are endothelial (or mesothelial) might well be raised if the study of smaller cavities did not indicate a different origin.

The larger cavities are situated toward the periphery of the cartilages; as one passes inward smaller cavities are found, some of which are lined and in a few instances partially filled with a fibrin-like material. This fibrin-like material is undergoing avascular organization by cells derived from the surrounding fibrous tissue in the neighborhood. Toward the inner margin of the cartilages there is a profound change of the texture of the fibrocartilage giving an appearance of irregular areas slightly stained or not stained at all, traversed and surrounded by normal appearing densely stained fibrous tissue of a character found in fibrocartilage. In but few places in any of the three specimens can cartilage normal for fibrocartilage be found. The appear-

ances indicate that the first step in the sequences of cyst formation is a dissolution of the cartilage matrix and disappearance of the cartilage cells. In the specimen from Case 3, some of these areas contain deposits of amorphous calcium salts. In all three specimens one finds in this rarified and ordematous appearing tissue small cavities, most of which contain a deposit of fibrin-like material. There are evidences of reparative reaction on the part of fibroblasts in all three specimens, but most noticeable in that from Case 1, and here there is a striking avascular organization of degenerated areas. Clusters of fibroblast cells indicate that chondroblasts are playing some part in this repair, but the general effect of the repair is to isolate by organization foci containing liquid and fibrinoid material. Evidence also of the coalescing of small cavities is present. At the peripheral border of the cartilage there seems to be an increase in vascularity as if there had been new capillary formation. There is no inflammatory reaction other than occasional lymphoid cells and the presence of mononuclear phagocytes containing hemosiderin pigment. Small arteries and veins are normal.

I should answer your inquiries regarding special lining of the cysts in the negative. The interpretation of my brief report is that the cavities arise in foci of degeneration in the fibrocartilage taking origin in the matrix of cartilage and it would seem that in some instances this should lead to the formation of calcified deposits demonstrable in gross as is evidenced microscopically in Case 3. The ordinary sequence, however, in these semilunar cartilages seems to be the formation of cavities due to the accumulation of liquid, probably by osmosis. The character of the fibrinoid material should be investigated through appropriate staining methods. I suspect that it is not fibrin, but an atypical product of adjacent fibroblasts. It eventually becomes com-



pletely replaced by dense concentrically arranged fibrous tissue. I am quite certain that you can exclude a lymphatic or synovial origin for these cysts.

Taking the pathological report of Dr Wolbach as a basis it is reasonable to assume that the exciting cause of these cysts might be an injury but such an assumption cannot explain the evident progressive degeneration of the cartilage over a period of months or even years after the injury.

Fisher (3) believed that the outer third of the semilunar cartilages derived their nourishment from blood vessels that entered the cartilage on the periphery. The inner two thirds on the other hand derived its nourishment from the synovial fluid. His reason for this belief was based on his observation that in transverse tears of the semilunar cartilage the outer third healed by dense fibrous tissue while the inner two thirds failed to heal at all.

This power of repair on the part of the outer third of the semilunar cartilage might logically be explained by the better blood supply of that part of the cartilage or by the invasion of fibroblasts from the fibrous tissue present about the periphery of the cartilage. Moreover the failure of the inner two thirds of the cartilage to unite might be due to a feeble blood supply, lack of immobilization, the tendency of the torn ends to retract or to a combination of all three factors.

In all the cysts reported the main cyst representing the most advanced state of the degenerative process was in the periphery of the cartilage which would support the belief that a serious interference with the blood supply of this region was the exciting cause of the degeneration. The observation of Dr Wolbach in his report of the histological study of the three cases here reported that toward the inner margin of the cartilage there is a profound change in the texture of the fibrocartilage giving an appearance of irregular areas slightly stained or not stained at all

would lend support for the belief that the semilunar cartilage was nourished almost if not entirely by the blood vessels which enter the cartilage at the periphery and that the inner part of the cartilage being deprived of its source of nourishment by the original injury or by the degenerative process on the periphery also degenerated.

From the study of the cases here reported and a review of the cases previously reported it is our belief that these cysts represent the end result of a degenerative process caused by an interference with the blood supply of the cartilage in this region the exciting cause of which is a non lacerating injury.

The salient points about all the cases reported are

- 1 The cysts are multilocular
- 2 They have no endothelial lining (Exception Ollershaw's case)
- 3 They are filled with a mucoid substance
- 4 There is no evidence of inflammatory reaction about them
- 5 The cysts have in all cases been located in the midportion of the semilunar cartilage on the external border
- 6 A definite history of injury was present in almost half of the cases
- 7 The cysts reach their maximum size quickly and then remain stationary
- 8 Most of the patients were in the second decade of life
- 9 Spontaneous recovery is unknown and recurrences have taken place in those cases in which the entire cartilage was not removed
- 10 Pain is present on complete extension and on acute flexion of the knee

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## FRACTURES

A BRIEF ANALYSIS OF ALL THE FRACTURES TREATED AT THE NEWELL CLINIC AND SANITARIUM DURING THE YEARS 1920-1924 INCLUSIVE<sup>1</sup>

By E. DUNBAR NEWELL, B.S., M.D., F.A.C.S., EARL R. CAMPBELL, B.S., M.D., AND J. MARCH FRERE, M.D., CHATTANOOGA, TENNESSEE

**D**URING the years 1920 to 1924 a total of 1,527 fractures were treated at the Newell Clinic and Sanitarium of Chattanooga, Tennessee. These cases may be divided as follows:

Fractures	Cases
Chest	99
Elbow	7
Femur	50
Bones of the foot	326
Bones of the hand	333
Bones of the head and face	90
Humerus	29
Knee including patella	42
Leg including both tibia and fibula	139
Bones of the pelvis	52
Scapula	21
Clavicle	29
Spine	33
Radius	182
Ulna	75

In 35 of these cases (which of course does not include the operations necessary for fractures of the skull) it was necessary to do open operations as follows:

Open operation	Cases
Clavicle	1
Humerus	2
Elbow	3
Femur	3
Radius and ulna	5
Tibia and fibula	6
Patella	6
Maxilla	4
For depressed zygomatic arch	5

The most impressive fact found by this review of our cases was that there was only one non union in all of the 1,527 fractures and this was a fracture of the radius. In 1 tibia case it was necessary for the patient to wear a supporting brace for more than 2 years before the union became firm. But without any other treatment than an ambulatory brace to his leg the union became firm and now he walks without a limp, has no pain and there is no deformity. In another case of fractured tibia firm union was delayed for 1 year and in

several other cases of fractured tibia, firm union was delayed for 6 to 10 months. The treatment in all of these cases was an ambulatory splint after the first 2 months following the fracture. In no other bone in this series was there any marked delay in the normal time for firm union of the fracture.

There was 1 case of Volkmann's contraction in this series. The history of this case was as follows:

A boy, age 15, had fallen about 10 feet from a tree and landed on outstretched left hand fracturing both radius and ulna in the upper third. The X-ray showed marked overriding of both fractures. There was much swelling of the entire forearm and circulation in the hand was poor. Under general anesthesia the fractures were reduced and the forearm put up in anterior and posterior board splint well padded. The patient was put to bed in the hospital with an electric pad surrounding the splinted forearm. He was kept in bed in the hospital for 4 days under close observation. Before he left the hospital the bandages were removed, the forearm inspected and the splints loosely reapplied. At this time the circulation in the hand and fingers was very good but there were numerous blebs over the forearm. We removed the dressings and gently massaged the soft parts every few days and often every day for several months. In spite of all this precaution the patient developed a serious Volkmann's contraction.

I believe now that if I had not reduced the fracture at once but waited a few days for the swelling to subside and then done a careful open operation I would not have had this contraction.

The history of the only ununited case is briefly as follows:

A white man, age 39, had the right hand forearm and arm caught in a belt. The injury consisted in a transverse fracture of the right humerus in the middle third and an oblique fracture of the right ulna and radius  $2\frac{1}{2}$  and  $3\frac{1}{2}$  inches respectively from the wrist joint. Under general anesthesia the fracture was reduced. Anterior and posterior moulded plaster splints were applied to the arm and an anterior and posterior board splint was applied to the forearm. The bones of the humerus and of the



Fig. 1 Case 1 Transverse irregular fracture through medial third of left clavicle with marked displacement and overriding



Fig. 2 Case 1 Medial third of left clavicle two weeks after reduction showing very good alignment and approximation of bones

ulna united promptly. Four months after the fracture roentgenograms of the radius showed much callus formation but there was non union. All bones of the forearm showed atrophy. Five months later there was still no union of the radius, therefore a bone graft was placed. No infection followed this operation. Ten months from the date of the bone grafting all splints were removed but a leather brace was used as the graft did not grow; there was still non union and the bone graft was being gradually absorbed.

#### DIAGNOSIS

In all of these fractures the diagnosis was based on X ray findings. In no instance did

we depend on physical examination alone. We are firmly convinced that many fractures are overlooked even after the most painstaking physical examination if an X ray picture is not made. On the contrary many cases will be diagnosed as fracture when a physical examination and the history are depended upon without the aid of the roentgenogram. We regard the negative X ray report in many cases just as valuable both to the patient and the surgeon as the positive finding. Many years ago the writer formulated the following:



Fig. 3 Case 2 Transverse fracture through center of right patella with some separation of fragments



Figs. 4 and 5 Case 2 Functional results 3 months after open operation



Fig. 6 Case 3. Transverse (compound) fracture of both distal thirds of the right tibia and fibula with displacement.



Fig. 7 Case 3. Result after reduction (open operation) without use of retention sutures or plates.



Fig. 8 Case 4. Showing flexion of patient's fingers when he appeared for treatment for Volkmann's contraction.



Fig. 9 Case 4. End results showing complete extension of fingers.

rule which is rigidly carried out in our clinic. Whenever the blow or trauma has been sufficient to cause a fracture an X-ray plate must be made whether or not the physical findings indicate fracture. On hundreds of occasions we have been justified in this practice and we never offer any apologies for the extra expense the patient or industry has to bear for we know full well that if we did less the patient, industry and the attending surgeon would all suffer thereby.

#### TREATMENT

We find that in this series of 157 fractures it was necessary in our opinion to do only 35 open operations. Open operation was used when we could not properly reduce the frac-



Fig. 10 Case 4. Roentgenogram of arm in cast following operation for shortening of both bones.



Fig. 11 Case 5 Transverse fracture of right radius and ulna showing angulation overriding and displacement of bones



Fig. 12 Case 5 Three and a half months later showing results of reduction and callus formation without open operation

ture or the fracture was badly compounded. By simply enlarging the opening by direct open manipulation the reduction could be made more accurately and with less trauma. With few exceptions we are bitterly opposed to the open operation for the reduction of

fractures and the fact that we did only 35 open operations in 1,527 fracture cases proves our conservatism in this regard. We believe that the less skill the less experience the less patience the bone surgeon has the more he is inclined to do the open operation for the

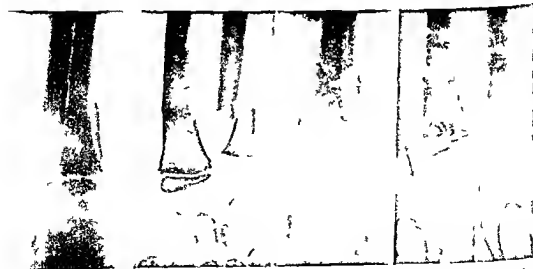


Fig. 13 Case 6 Roentgenogram taken after two attempts to reduce fractures

Fig. 14 Case 6 Roentgenogram showing results after open operation



Fig. 15 Case 7 Transverse fracture of proximal third of right femur with displacement and overriding of the bone

reduction of fractures. Despite our general antagonism to the open operation for reduction and maintenance of fractures there are some fracture cases in which we always advise the open operation.

In the fractured patella we always operate unless there is some reason why we should not because it has been our experience that we get better results from the open operation. When the fracture is caused by a direct blow on the patella and the ligaments are apparently not torn then an open operation may not be necessary but even in these cases when the fragments cannot be easily held in accurate apposition by position and splints we do the open operation. When the fracture is due to muscular violence we always do the open operation because in these cases the ligaments have been torn and unless they have been

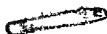


Fig. 16 One and a half months later showing results gotten with traction in a Thomas splint and Balkan frame after failure to reduce on Hawley table under anesthesia

carefully sutured a normal knee joint cannot be expected.

In depressed fractures of the zygomatic arch we have found that we get the most perfect results by the open reduction which is usually done under local anesthesia.

In fractures of both bones of the forearm we have at times been unable to get satisfactory reduction and maintenance without an open operation on one or both bones. In these cases when repeated efforts at reduction have failed we have found it far more satisfactory to do the open operation rather than to damage the soft parts further by renewed attempts at reduction and maintenance. In fractures of the bones of the forearm where the fragments are not easily held in place by position and splints we believe the open operation is the method of choice. In certain



Fig. 17

Fig. 18

Fig. 17. Case 8. Transverse fracture through middle of right femur showing anterior displacement of the superior bone with slight amount of overriding.

Fig. 18. Case 8. Results 16 months after open operation. (Note that all of bone plate has not been absorbed.)

mutating fractures of the forearm when the forearm is greatly swollen the circulation is poor and further trauma from the manipulation for reduction of the fractures would endanger the life of the limb the limb is placed in a hot pack for a few days and then the open operation is done. This same procedure is carried out in some of the mutilating fractures of the leg foot and ankle. Also in oblique fractures of the tibia when maintenance is difficult we advise the open operation.

In fractures around the elbow when satisfactory reduction and maintenance cannot be obtained by manipulation and position we believe that the open operation especially in adults offers the best functional and cosmetic results.

The method used in open operation is of the greatest importance. Some surgeons affect the no touch method with the ridiculous repeated resterilization of instruments as the important factor. The writer feels that the one factor in the success of all open operations

is the gentle handling of tissues by clean cut dissections. In doing this the blood supply to the bone is interfered with as little as possible the bone is never lifted from its bed by rough retraction unless absolutely necessary the periosteum is not disturbed the attached fragments of bone are not removed fractured ends are apposed without suturing or plating if this is possible and if this is not possible the smallest number of retention sutures or appliances is used to hold the ends in apposition. I prefer silver or bronze wire as the suture material of choice for holding the fragments in apposition. When this technique has been carried out infection delayed union or non union need not be feared.

We do not dread compound fractures when the blood supply has not been greatly damaged provided we see these cases a few hours after the injury. We shave the parts do a débridement use ether and iodine freely and suture the wounds without drainage or with just a rubber wick for 48 to 72 hours apply retention splints and do not expect infection or delayed union.

In all of our fractures of the femur in this series with the exception of the three open operation cases we used retraction with the Thomas splint and the Ballan frame. We have found that continuous traction is far more effective in reducing an overriding fractured femur than is a general anæsthetic and the Hallev table. The greatest amount of traction must be put on during the first few days or until the overriding has been overcome and then the amount of the traction is lessened so that the ligaments of the knee joint are not injured. In fractures below the knee we use circular plaster casts or molded plaster splints with a foot piece.

In fracture of the humerus we use a Thomas splint while the patient is in bed and when he is up we use the plaster cast splint that holds the arm at right angles to the body. This splint is used only when it is difficult to hold the fractured ends in good apposition.

In fracture of the forearm we prefer the molded plaster splint or the anterior and posterior board splint well padded. However the kind of splint is of little importance. Accurate reduction of these fractures of the fore

arm is essential if we are to get 100 per cent functional and cosmetic results whereas in fractures of the femur, if we have good alignment we are content with 10 per cent apposition. In fact we would not think of doing an open operation on the femur in a child even though nothing more than the edges were apposed because in children bone defects of the femur have such a marvellous faculty of becoming corrected. In adults we are never content with less than 10 per cent approxima-

tion but in only 3 of 50 cases has it been necessary to do more than to use continuous traction with properly placed pads to get this amount of approximation.

Our fractures are inspected often splints being removed and soft parts massaged as we believe this prevents non union by stimulating the circulation in the limb, prevents pressure injury to the soft parts, prevents atrophy of muscles and gives an opportunity for early passive motion in the joints.







FIGS 1 and 2 Case 1 Before operation and after operation

between it and the tibialis posticus on to and through the periosteal covering of the astragalus and os calcis. A chisel slightly curved on the flat was introduced through this incision down to the bone and with a series of mallet taps a raw bony area about 1 inch long by  $\frac{1}{2}$  inch wide was made by chipping back the periosteum and a thin under



FIG. 3 Case 1 After operation.



FIG. 4 Case 1 Six months after operation.

lying area of bone. The tibialis posticus and flexor longus digitorum and the neurovascular bundle overlay this periosteal flap and were safely displaced backward by the underlying chisel. The periosteum covering the lower epiphysis of the tibia was divided vertically and separated by the chisel on each side leaving the bone raw and chips of it adhering to the separated periosteum on either side. This wound was now covered up by the skin flap and gauze and a J shaped incision was made on the outer side behind the fibula and over the os calcis as on the inner. The periosteum of the os calcis was divided in front of the peroneal tendons and with the chisel a similar denudation was made as on the inner side. The periosteum covering the lower epiphysis of the fibula was next divided and osteoperiosteal flaps were reflected to each side. The two sides of the ankle were now ready for the reception of the grafts the wounds were covered up and the tourniquet removed. Osteoperiosteal grafts from the antero-internal surface of the tibia were obtained as described in the previous case and placed in position without sutures the outer reaching from the fibula to the os calcis the inner from tibia to astragalus and os calcis and the wounds were closed.

CASE 3. Ethel W. aged 9 was admitted to the Home on September 9 1919 with infantile paralysis affecting both legs a bad paralytic scoliosis a dislocated right hip. Her right foot was flail.



FIG. 5 Case 3 Three years and 10 months after operation



Figs 6 and 7 Case 2 Before and 3 years after operation

Operation November 28 1921 was done on her right foot exactly as described for Case 1 so that details are unnecessary

The photographs before and after operation and the X ray pictures show that the object of the operations have been fully realized. All of these patients have firmly fixed ankle joints and their feet are now capable of serving a useful purpose.

It will be noted that in each case there is swelling about the ankle joint. Though the X ray does not clearly show this it is due to new bone formation judged by its hard consistency on palpation.

These operations though easy require attention to every detail if success is to be assured so we make no excuse for describing our methods.

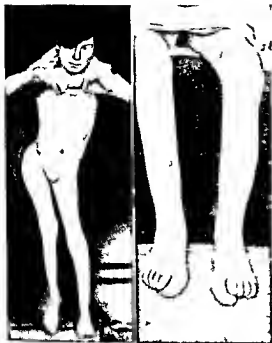
The skin covering the limb to be operated upon is prepared the night before in the ordinary way covered with sterile gauze and a bandage and these are taken off on the operating table after the tourniquet has been applied. The skin is then mopped with Harrington's solution for 2 minutes and this is wiped away with spirit. The sterilized instruments lying in 1 in 20 carbolic solution have hot water poured over them to dilute the carbolic to 1 in 60. Immediately before use the instruments are wiped dry with sterile gauze. The skin involved in the incisions is transversely scratched to allow of accurate suturing at the end of the operation. Only prepared instruments and sterile mops wrung out of warm saline are allowed to touch the wounds; no fingers gloved or otherwise being allowed. As soon as the osteoperiosteal flaps are separated at each end they are



Fig 8 Case 2 Three year after operation



Fig 9 Case 2 Roentgenogram 3 years after operation



Figs. 10 and 11 Case 3 Before operation (1921) and after operation (1923)

caught by the four corners in four pairs of fine toothed catch forceps 2 two above and two below

If the graft is cut in two eight pairs are required. The bed for the graft is exposed by holding the edges of the divided periosteum apart with catch forceps showing the raw bone area on to which the graft has to be laid. The reasons for this are (1) to prevent the grafts from curling up or folding over and to keep them spread out ready for use and (2) to keep them from falling when detached. Bone grafts have been known after their separation to find their way on to the floor and it is well to make such a calamity impossible.

The tourniquet is removed at the end of the first stage because these patients all have cold limbs to which the blood supply is defective and damage from too long application of the constrictor is more likely to happen to them than to normal limbs. Haemorrhage has not occurred in



Fig. 12 Case 3 Three years after operation (February 12 1924)

any of our cases and the wound is usually sufficiently dry before the grafts are in position. The grafts should be lifted directly off the tibia and placed without avoidable loss of time in their proper places. If spread out and flattened they lie in position and sutures are only an unnecessary complication. The skin wounds after the skin has been mopped all round with spirit are closed with interrupted sutures of catgut and dressed with sterile gauze on the outside of which powdered boracic acid is sprinkled from a flour dredger. Outside of this comes a thick layer of cotton wool two lateral gouch splints reaching from the tibial condyles above to the sole of the foot below fixed by an ordinary bandage. At the lower end the foot and ankle are fixed by a spat of plaster of Paris above by a broad garter of plaster of Paris and the foot and leg are hung in a cradle.

In all of our cases the dressing has not been removed for a month the wounds were then all dry and healed and the catgut was absorbed the knots lying on the dressing. After washing with spirit the leg has been put into plaster of Paris for another 6 weeks.

Whether the posterior or lateral operation is to be preferred we cannot yet decide as both have given equally good results. One advantage of the posterior incision is that only a single wound has to be made for the grafts.

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# A SIMPLE METHOD FOR CORRECTION OF DEFORMITY IN BONY ANKYLOSIS OF THE HIP JOINT<sup>1</sup>

By IEROY C ABBOTT M.D. F.A.C.S. AND FRED A JOSTES M.D. St. Louis Missouri

THE treatment generally indicated in ankylosis of the hip joint with deformity is correction of the deformity by osteotomy of the femur with immediate realignment and fixation of the limb in a good functional position for weight bearing. The simplest and the most frequently employed type of osteotomy consists of a transverse section of the bone just below the level of the trochanters. The objection to its use however is that in severe deformities after the osteotomy is completed the bone ends frequently slip by when the deformity is corrected. This may lead either to non union or union with shortening in either case the result is bad.

To overcome this difficulty various types of osteotomy have been devised the best known of which are the cuneiform osteotomy and the curved osteotomy of Brackett. The former consists of the removal of a wedge of bone with its base facing in a direction varying with the character of the deformity present. In the latter the section of the bone is curved and correction of the deformity is obtained by rotation the convexity of the lower fragment turning within the concavity of the upper. Slipping of the bone ends is prevented by the shelving edges of the upper fragment. Neither

of these methods however constitutes an absolute safeguard against displacement of the fragments moreover in certain deformities they have not proved suitable. If the hip is ankylosed in a position of extreme abduction flexion and external rotation it is often impossible to plan either a cuneiform or curved osteotomy with any reasonable assurance that the component parts of the deformity will be corrected. Even if the plan seems feasible its execution is attended by serious technical difficulties and because of the marked contracture of the soft parts immediate correction of the deformity is almost certain to be followed by a displacement and overriding of the fragments. It was just such a deformity in a young lad admitted to the Shriners Hospital for Crippled Children which lead to the development of the method of treatment to be described.

The method is based on the principle of treatment of mal united fractures which has been emphasized by Sir Robert Jones (1, 2). He has shown for example that in recent mal union of the femur correction of angulation can be secured by gradual pressure over the site of fracture and by extension of the leg on a Thomas splint. In certain cases manipulation under anesthesia followed by the application of strong traction may be necessary. One of us (L. C. A.) has combined manipulation and caliper extension in a

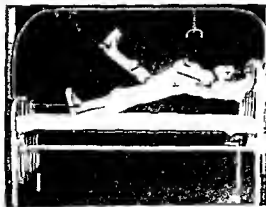


Fig. 1. Illustrating the method of securing fixation after osteotomy of the femur for correction of flexion and abduction deformity of the right hip. The position of deformity is maintained by fixing the lower end of the Thomas splint to a long tubal arm until callus is formed. The adjustable socket into which the tubal arm fits permits of a gradual change in the position of the splint until the deformity is corrected.

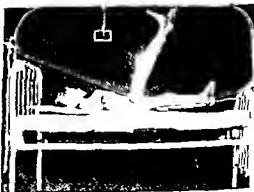


Fig. 2. Illustrating the method of fixing the pelvis in correction of flexion deformity of the left hip. Traction is applied to the left leg while the right is held on a Thomas splint with the hip flexed and the knee extended. In this position the taut hamstrings prevent hyperextension of the spine.

group of mal united fractures of the femur. The details of the method of application and the results secured have been published in a previous article (3). The point of fundamental importance to the surgeon however is that in the early stages of the mal united fracture the bone ends are surrounded by a soft callus. The plastic character of the callus permits correction of the deformity by a gradual molding without serious risk of displacing the fragments.

The practical application of this principle in the correction of deformity of the hip with bony ankylosis is realized in the following manner:

A subtrochanteric osteotomy of the femur is done and the limb is fixed in the position of deformity by applying a Thomas splint with traction. When callus has surrounded the bone ends gradual correction of the deformity is obtained by changing the position of the limb. For example in abduction deformity the leg is gradually adducted until it becomes nearly parallel to its fellow. With each change in position a bending of the callus occurs. When the final position of correction is secured we have produced a definite angulation at the site of osteotomy. We have obtained correction of the deformity therefore by creating a mal united fracture of the femur but without any displacement of the fragments.

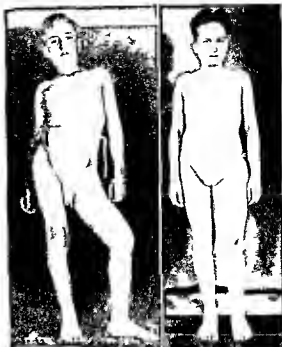


Fig 3

Fig 6

Fig 3 Case 1 Condition on admission Bony ankylosis with deformity of abduction flexion and external rotation  
Fig 6 Case 1 Complete correction of deformity



Fig 4



Fig 5

Figs 4 and 5 Roentgenograms showing extreme abduction deformity with bony ankylosis and solid union of fragments after correction of deformity

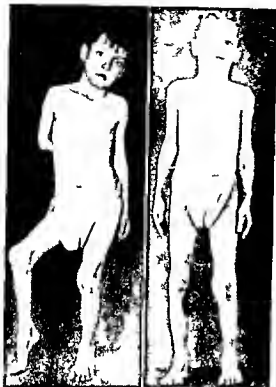


Fig 7

Fig 9

Fig 7. Case 2. Condition on admission. Abduction, flexion and external rotation of the right hip. Patient walks with only the toes touching the ground.

Fig 9. Case 2. Correction of deformity obtained by osteotomy of the femur and a gradual bending of the callus.

The desired position for function is maintained until consolidation of the callus has taken place. The description of the method is best given under the following headings:

1. Subtrochanteric osteotomy of the femur
2. Fixation of the leg until the fragments are imbedded in the callus
3. Gradual correction of the deformity
4. Protected weight bearing

**Subtrochanteric osteotomy of the femur.** If the deformity is one of abduction and external rotation a vertical incision 4 to 5 inches in length is made on the anterior aspect of the thigh beginning just below the anterior superior spine of the ilium. The deep fascia is divided in the line of the skin incision and the interval between the tensor fasciae femoris and sartorius is seen. When these two muscles are separated the tendinous portion of the rectus is exposed and on its lateral aspect is the upper part of the vastus lateralis.

At this stage it is usually necessary to locate the transverse branch of the lateral circumflex artery. The femur is exposed by retracting the rectus muscle inward and the vastus lateralis muscle outward. A vertical incision is made through the periosteum and a transverse osteotomy is performed. The periosteum and deep structures are approximated by interrupted catgut sutures while the skin is closed with silk. The limb is then fixed in its position of deformity by applying a Thomas splint with adhesive traction.

In flexion and adduction deformities we have made the incision on the posterior external aspect of the trochanter and upper femur. A part of the fibrous expansion of the gluteus maximus is divided with exposure of the vastus lateralis. This muscle is divided in the line of its fibers and the periosteum is incised vertically. A transverse subtrochanteric osteotomy is then performed and the wound closed in the manner described in the preceding paragraphs.

**Fixation of the leg until the fragments are imbedded in callus.** The patient is placed on a Bradford frame, the upper end of which is suspended to the head of the bed by heavy leather straps. This arrangement permits use of the bed pan without changing the position of the patient. In our first case we secured immobilization of the leg by pillows and sand bags, but more recently we have made use of an overhead bed frame. Our bed frame is a modification of the frame designed by Robert Morrison of the Royal Infirmary, Edinburgh. It is constructed of gas pipe with upper and lower uprights which clamp on the ends of the bed. They are joined by a horizontal bar. Adjustable sockets into which can be fitted tubal arms of various lengths allow for fixation of the limb in any position desired. The frame is portable and can be easily and quickly adjusted. The leg is immobilized in the position of the deformity by maintaining traction and fixing the lower end of the Thomas splint to a horizontal tubal arm (Fig 1). At the end of the fourth or fifth week the roentgenogram will usually show abundant callus surrounding the bone ends. We are now ready to begin the correction of the deformity.

**Gradual correction of the deformity.** The correction of the deformity is secured by a gradual change in the position of the leg. Figure 1 shows the leg held in abduction and flexion. In such a case the treatment is begun by turning the tubal arm downward and inward. Each day the lower end of the Thomas splint is brought a little nearer to the midline. With each successive change there is a bend in the callus surrounding the fragments. This bend is not acute but gradual.



Fig 8

Fig 8 Case 2 Right angle abduction of the hip with complete ankylosis

Fig 10 Case 2 Roentgeno gram showing how correc-



Fig 10

tion of deformity was secured by movement at the hip joint and at the site of osteotomy. The fragments are solidly united

ual and the roentgenograms of the completed cases show a very smooth and rounded curve at the site of the osteotomy. The time required for correction of the deformity in the average case is about 4 weeks. When this position is obtained the limb is fixed until clinical examination and the roentgenograms indicate consolidation of the callus. The apparatus is then removed and the patient allowed to move about in bed.

Control of the pelvis during the period of correction is absolutely essential. It can be secured by the application of traction to the opposite leg. In correcting the deformity of abduction traction is applied with the opposite leg held in line with the trunk in adduction with the opposite leg held in full abduction. Fixation of the pelvis and lumbar spine during the correction of flexion deformity is obtained by holding the sound limb on a Thomas splint with right angle flexion of the hip and complete extension of the knee. In this position the hamstrings are held taut and arching

of the lumbar spine false correction is entirely prevented (Fig 2).

This method of fixation with the lumbar spine suggested itself to us through the use of the Thomas test for hip flexion. To ascertain accurately the amount of flexion in pathological conditions of the hip joint Thomas prevented hyperextension of the lumbar spine by holding the flexed thigh against the abdomen. It occurred to us that the same object could be attained during the correction of flexion deformity of the hip by holding the opposite thigh at right angles to the trunk with the knee extended. This method is especially useful for correction of flexion contracture of the hip in cases of infantile paralysis. We have also found it of great value in completing extension of the hip after fasciotomy of the hip flexors. The fixation is far superior to that obtained by either a plaster jacket or strapping the pelvis to a Bradford frame. We have not observed this method in other clinics nor have we seen it in the literature.





Fig. 11

Fig. 14

Fig. 11. Case 3. Condition on admission. Hip on abduction and internal rotation of the right hip.

Fig. 14. Case 3. Position of correction secured by osteotomy and gradual molding of the callus.

During the period of consolidation of the callus the thigh and calf are massaged and the quadriceps muscle is exercised. After the apparatus has been removed exercises of the knee are begun. There will be some stiffening of this joint incident to immobilization, but this is readily overcome by a competent physiotherapist.

**Protected weight bearing.** As the tests for consolidation of callus are not absolute we have found it a good practice to use a protective weight bearing appliance when the patient becomes ambulatory. For this purpose the Thomas walking caliper splint is both simple and practical. It is worn for several months and gradually discarded. It is finally removed when careful and repeated observation shows no tendency to any increase in the deformity at the site of osteotomy.

The advantages of this method of correcting deformities of the hip joint are that it renders

unnecessary the use of complicated osteotomies. A simple operation is substituted for a difficult one. Through its use the contracted soft parts are gradually stretched so that there is little risk of displacement of the fragments. In the ordinary osteotomy the limb is fixed postoperatively in a plaster of Paris spica and it is very difficult to determine whether the desired position of correction has been obtained without resorting to frequent changes of plaster. With this method the limb is free for inspection throughout the treatment and the necessary changes can readily be made.

#### RESULTS

Four cases have been treated by this method. The first 3 had deformities of abduction, flexion and external rotation. The type of deformity present is shown in Figures 3 and 4. One patient had a quiescent tuberculosis of the hip with a deformity of adduction, flexion and internal rotation. Correction of the deformity was obtained and there was great functional improvement in every case.

The difficulties of determining the presence of bony ankylosis of the hip joint was forcibly demonstrated by Case 5. An incomplete bony ankylosis was suspected after a study of the roentgenograms, but a careful examination under anesthesia failed to detect motion. A subtrochanteric osteotomy was performed and the roentgenograms (Figs. 8 and 10) show that the greatest amount of correction was secured through motion of the hip joint. In all probability correction of the deformity could have been secured without osteotomy. In the fourth case there was some displacement of the fragments which was probably brought about by inadequate fixation of the limb while waiting for callus to form. In deformities in which fixation is difficult it would seem desirable to apply a plaster of Paris spica and remove it by bivalving before operation. Immobilization could then be obtained by its reapplication following operation.

The results obtained in these 4 patients were excellent and we feel justified in advocating the method as a substitute for the ordinary osteotomy. It will be found extremely useful in correction of complicated deformities of the hip joint with bony ankylosis.

#### CONCLUSIONS

1. Correction of the deformity in ankylosis of the hip joint is generally secured by a subtrochanteric osteotomy of the femur. In cases with marked deformity however there is a great risk of displacement and overriding of the fragments.



Fig 12

Fig 12 Case 3. Roentgenogram showing almost complete destruction of the head and neck of the femur. Bony ankylosis is questionable.



Fig 13

Fig 13 Case 3. After osteotomy of the femur showing some displacement of the fragments probably due to inadequate immobilization following operation.



Fig 15

Fig 15 Case 3. Final result. Union of the fragments with consolidation of the callus.

2. The risk of displacing the fragments is minimized by using the cuneiform and curved types of osteotomy.

3. The objections to these methods are that in certain types of deformity the execution is extremely difficult and often impossible. They do not constitute an absolute safeguard against slipping of the fragments.

4. The method described which combines a simple transverse osteotomy with a subsequent molding of the callus to secure correction of the deformity has been found by us to be very simple and entirely satisfactory.

**CASE 1.** W. H., a male age 14, was admitted to the Shriners Hospital for Crippled Children May 23, 1924, complaining of stiffness and deformity of the left hip. In September, 1922, the patient jumped from a raft and that evening he complained of pain in the left hip. Three days later he was confined to bed with high fever and the left hip began to swell. He was taken to a hospital where a diagnosis of tuberculosis of the left hip was made and a light and pulley traction was applied. During the next 6 weeks the pain continued and the swelling increased until the left hip was twice the size of the normal one. From this time on the swelling gradually decreased. The traction was removed at the end of the tenth week and the hip

gradually drew upward. In March, 1923, he was discharged from the hospital. The hip remained swollen and deformed. At the present time there is no pain, but the patient's gait is very awkward because of the deformity.

**Physical examination.** The patient is a well-nourished boy. The general examination is essentially negative. The left hip is held in a position of extreme abduction, flexion, and external rotation. There is a marked thickening of the soft tissues in the groin, anterior surface of the upper thigh and over the crest of the ilium. The entire left thigh is much larger than the right. There is no motion of the hip in any direction. In walking the pelvis is tilted downward on the affected side with a compensatory curvature of the lumbar spine. The gait is very slow and awkward (Fig. 3).

**Roentgen ray examination.** May 3, 1924, showed a deformity of 90 degrees abduction and there is solid bony ankylosis. The diagnosis was old osteomyelitis of the head and neck of the femur with involvement of the joint and bony ankylosis (Fig. 4).

At operation May 29, 1924, an incision was made on the anterior aspect of the thigh in the manner described above. Considerable difficulty was experienced in exposing the femur because of the mass of scar tissue encountered. The bleeding from the scar tissue was profuse. A transverse osteotomy of the femur was done and because of the possibility of lighting up the old infection the wound was packed open with gauze saturated with acriflavine. Counter drainage was established by a stab wound in the buttock. A Thomas splint was applied and immobilization secured by pillows and sand bags.



Fig 19

Fig 16

Fig 16 Case 4. Condition on admission. A marked deformity of abduction and flexion.

Fig 19 Case 4. Final result. Complete correction of the deformity.

June 5 1924. The postoperative convalescence was uneventful. Dressing of the wound showed it to be clean. Immobilization of the leg was continued.

June 17 1924 the roentgen ray examination showed abundant callus formation with no displacement of the fragments. During the next 3 weeks the deformity was corrected by gradually adducting and internally rotating the leg. June 28 1924 the roentgen rays showed a bending of the callus and no displacement of the fragments. Immobilization was continued until August 23 when the roentgenograms indicated consolidation of the callus (Fig 5). The wound is completely healed. A Thomas walking caliper splint was applied and worn until the first week in October. It was then gradually discarded and the patient was discharged from the hospital October 29.

January 19 1925 the patient returned to the hospital for observation and examination showed about 20 degrees of abduction and 20 degrees of flexion. There is no pain and he walks with only a slight limp. The functional result is excellent (Fig 6).

CASE 2. A P. a male age 7 was admitted to the Shriners Hospital for Crippled Children August 19 1924 complaining of deformity and stiffness of the right hip. In February 1924 the patient fell down a flight of steps

injuring the right hip. For the next 2 weeks there was pain in the hip and fever. An abscess formed and was lanced. Drainage continued for about 3 weeks when the wounds were healed. Weight and pulley traction were used during the acute stage. When these were removed the leg was drawn upward until it reached its present position of deformity. Now he walks with the right leg held in wide abduction and with only the toes touching the ground.

Physical examination. The patient is a fairly well developed boy with the right hip held in a position of extreme abduction flexion and external rotation. In walking only the toes on the right side touch the ground and the gait is very awkward. No motion can be detected in any direction. There is no pain or sensitiveness of the joint (Fig 7).

Roentgen ray examination, August 19 1924 showed the thigh abducted 90 degrees. There is destruction of the joint cartilage. The diagnosis is suppurative arthritis of the right hip joint and incomplete ankylosis (Fig 8).

At operation August 25 1924 a subtrochanteric osteotomy was done through the usual anterior incision. The leg was held in the position of deformity by traction on a Thomas splint. This was maintained for 15 days.

September 8 1924 correction of the deformity was begun by gradual adduction of the leg. September 23 1924 roentgen ray examination showed correction of the deformity with the fragment held in a mass of callus. The leg was then immobilized for 6 weeks.

Roentgen ray examination October 30 1924 showed complete correction of the deformity with union of the fragments. It was interesting to note here that the deformity was corrected by movement both of the hip joint and at the site of osteotomy. It seems likely that correction of the deformity could have been secured without osteotomy knowing that there was not complete ankylosis of the joint. A short plaster of Paris spica was applied and the patient allowed to walk. January 1 1925 he was discharged from the hospital wearing the plaster spica.

April 1 1925 the spica was removed and the examination showed the hip held in slight abduction and slight flexion. He walked with only a slight limp (Fig 9). The roentgen ray examination (Fig 10) showed correction of the deformity with solid union of the fragments. A new spica was applied and he walked. The patient was to return in 6 months.

July 10 1925 a letter from the family doctor stated that a month ago the patient fell and sustained a supracondylar fracture of the left femur. This has healed in good alignment and with full length. The position of the hip is excellent and he walks with only a slight limp.

CASE 3. V. G. a female age 25 was admitted to the Shriners Hospital for Crippled Children September 19 1924 complaining of stiffness and deformity of the right hip. At 18 months of age the patient had difficulty in walking and the hip seemed stiff. There was pain in the right knee and fever at irregular intervals. The hip gradually became deformed but at 3 years of age the child began to walk. She has not been under the care of a physician and at the present time 15 years after the onset there is an extreme deformity of the hip which makes walking very difficult.

Physical examination. The general examination is negative. The right hip is fixed in a position of 70 degrees flexion and 15 degrees adduction (Fig 11). There is about 3 inches of shortening the major portion of which is confined to the femur. No motion is present in the hip in any direction. The gait is extremely awkward due to the very marked deformity and shortening.

Roentgen ray examination September 9 1924 showed an old destructive process of the right hip. The head and most of the neck of the femur were missing. The dia-



Fig 17

Fig 17 Case 4. Roentgenogram showing fusion of head of the femur and acetabulum.



Fig 18

Fig 18 Case 4. Roentgenogram after osteotomy of the femur and gradual molding of the callus.

sis was tuberculosis and probably incomplete ankylosis (Fig 12).

At operation September 18, 1924, through a posterior lateral incision a cuneiform osteotomy was done for at the outset it was decided to try to correct the deformity in this manner. The marked contracture of the soft parts prevented this correction so the leg was immobilized by means of traction on a Thomas splint.

September 28, 1924, the day after operation, the patient had a high fever which continued for a week, after which the temperature gradually returned to normal. This was probably due to a tuberculin reaction from the old tuberculous joint as the wound healed by first intention.

October 10, 1924, a gradual correction of the deformity was begun and final position of correction was secured in about 3 weeks.

Roentgen ray examination October 23, 1924, showed some displacement of the fragments (Fig 13). This was possibly due to inadequate immobilization of the limb while waiting for callus to form. In the deformity of flexion and adduction it would seem best to fix the limb postoperatively in a plaster of Paris spica. Roentgen ray examination November 21, 1924, showed correction of the deformity and consolidation of the callus. The patient remained in bed until December 10, 1924, when a plaster of Paris spica was applied. She was then allowed to walk.

January 9, 1925, the patient was discharged wearing a plaster of Paris spica.

March 18, 1925, she returned walking quite well; the spica was removed. The position of the hip was satisfactory except that there seemed to be a slight increase of flexion (Fig 14).

Roentgen ray examination March 18, 1925, showed complete correction of the deformity with union of the fragments (Fig 15). A new spica was applied and the patient was to return in 3 months. In all probability the hip joint was not solidly ankylosed and fixation should have been continued for a year or more.

July 22, 1925, the patient returned for examination. She walked very well and there was no pain at any time. No motion could be detected and there was no sensitive area. The functional result is excellent.

CASE 4. J. W., a male age 16, was admitted to the Shriners Hospital for Crippled Children, October 14, 1924, complaining of stiffness and deformity of the left hip. At the age of 6 years the patient had pain in the left hip which necessitated treatment in a hospital. Traction was applied and this was followed by fixation in a plaster of Paris spica. No further history could be obtained as patient lived in a Masonic Home and his parents were dead. At examination he walked with a very marked limp because of the deformity of the left hip.

Physical examination. The patient is a very well developed and nourished boy. In standing there is a very marked lumbar lordosis with 90 degrees of flexion of the left hip and about 35 degrees of abduction (Fig 19). There is no motion of the joint in any direction and no pain is elicited on a forcible attempt to move the joint.

Roentgen ray examination (Fig 17) showed fusion of the head of the femur and acetabulum.

At operation October 10, 1924, through an anterior incision a subtrochanteric osteotomy was done in the usual manner. A Thomas splint and traction was applied holding the leg in the position of deformity. The lower end of the

splint was fixed to a long tubal arm of an overhead bed frame

October 30 1924 Convalescence was uneventful The stitches were removed and the wound showed healing by first intention

Röntgen ray examination November 23 1924 showed sufficient callus to allow for correction of the deformity As there was marked flexion the lumbar spine was controlled by holding the opposite leg on a Thomas splint with the hip flexed and the knee extended Complete correction of the deformity was secured in 5 weeks Immobilization was continued and massage and exercises of the knee begun

February 2 1925 a plaster of Paris spica was applied and the patient allowed to walk

February 12 1925 the patient was discharged wearing a plaster of Paris spica

April 4 1925 The patient returned at intervals of one month On this visit the roentgen rays show complete correction of the deformity and solid union (Fig 18) The hip is held in excellent position with only slight flexion and slight abduction He walks with scarcely any limp (Fig 19) The functional result is excellent

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TRACTION ON THE STERNUM IN THE TREATMENT OF MULTIPLE FRACTURED RIBS<sup>1</sup>

BY T. HANFORD JONES, M.D., ROCHESTER, NEW YORK

AND

E. P. RICHARDSON, M.D., BOSTON, MASSACHUSETTS

THE benefit obtained by skeletal traction on the sternum in a case of multiple fracture of the ribs causing marked interference with respiratory exchange seems to warrant a brief report in the hope that the principle utilized may prove of value although the type of injury in which treatment by this method might come into consideration is most unusual. Doubtless the procedure here employed or some modification of it has been used by others but descriptions of such cases are not frequent in medical literature. The indications for its application can best be studied by a consideration of the case in question.

CASE. No. 264348. J. G., a female aged 32, was admitted to the hospital at 3 p.m. July 17, 1934. The patient had been run over by an automobile shortly before entrance the machine had been seen to pass over the left side of the chest. The patient a normally developed white child was in profound shock at the time of admission. The blood pressure was 78-30 pulse barely perceptible rate 140-150. The skin was of an ashy gray appearance cold and clammy. There was extreme cyanosis the mucous membrane and finger tips being almost purple. Respirations were very rapid rate 50-60 per minute and labored. With each inspiration requiring great muscular effort on the part of the patient the sternum and anterior part of the left chest retracted to an extreme degree so that it was obvious at a glance that there were several fractured ribs. On examination it was found that the second to the eighth ribs inclusive were fractured at points corresponding to the nipple line. Laterally the broken ends of the ribs could be seen protruding under the skin about a centimeter above the level of the medial ends. In the left axilla there was a localized area of subcutaneous emphysema. There was no evidence of fluid in the chest or in the pericardial sac. The heart was not displaced and was negative on auscultation. The abdomen was held rigid although there was no especial tenderness peristalsis and fluid demonstrable in short no definite evidence of intra-abdominal injury. The urine was negative.

Treatment. The usual first aid treatment for shock was administered immediately. In addition it being obvious that the patient was likewise suffering from a severe degree of anoxemia oxygen was administered. The effect of the latter was very satisfactory a few inhalations serving to clear up the cyanosis while respiration became much easier. However immediately upon cessation of oxygen administration the patient's condition became alarming so that it was necessary to give oxygen inhalation intermittently. It was quite apparent that the cyanosis and rapid labored breathing were due to deficient ventilation resulting from rigidity of the thoracic wall. Each inspiratory effort caused a depression of the partly mobilized flexible sternum and the attached rib ends rather than an entrance of air into the lungs. While it was possible for the moment to

combat the anoxemia by the use of oxygen it was feared that further encumbrance on the vital capacity as a result of hemorrhage or reaction of the lung to trauma might be fatal particularly in view of the profound shock. It was also obvious that if the sternum could be fixed so that retraction did not take place respiration would be easier. Accordingly traction was applied to the sternum in the following manner:

Technique. Under procain anesthesia two small incisions about 1 centimeter long were made just lateral to and at right angles to the border of the sternum at the level of the third interspace and were carried down until the edges of the sternum were exposed great care being taken to avoid puncture of the pleura. An ordinary bullet forceps such as is used to grasp the cervix in gynecological cases was used to grasp the sternum a hook being placed into the lateral aspect of the sternum on each side and the forceps then being locked. It was found that a moderate degree of traction served to keep the sternum elevated during inspiration. The optimum degree was determined by hand and maintained by the usual method of weights and pulleys attached to a rainbow frame.

Hospital course. On application of traction between 4 and 5 p.m. the respiration which had been between 50 and 60 without the use of oxygen dropped to 40 and was much easier the patient complaining of no discomfort from the pull on the sternum. Further administration of oxygen was not necessary. The respiratory rate remained between 35 and 40 until late in the evening at which time it rose to 48 only to drop again to 38 within a few hours. The blood pressure rose steadily. On July 17 the day following the patient's admission the patient's condition was much improved. She rested quite comfortably all day. The pulse rate was still rapid at 140 but had improved in quality the blood pressure being 120-50. The patient's color was much better although there was still slight cyanosis. Respiration was much easier and the rate had dropped to an average of 35. The traction forceps slipped from the sternum during the morning with the result that the pull was being exerted on the skin and fascia of the chest wall. Inasmuch as the traction thus obtained seemed adequate an attempt was made to reapply it to the sternum. July 19 the second day after admission the patient showed further improvement. The general appearance was much better cyanosis being practically absent. The pulse was still rapid the rate 130 but of good quality. Her respirations were 30 but quite normal in character. The patient appeared comfortable and did not complain of the traction which was temporarily discontinued to note the effect on respiration. As its omission did not seem to influence the breathing it was removed. The respiratory rate remained unchanged. However there was again marked deformity of the chest with retraction of the sternum on inspiration.

The remainder of the patient's convalescence was uneventful. Attempts to modify the deformity by adhesive traction or by swaths were unsuccessful. She improved steadily and was discharged on August 7 at which time she was capable of ordinary activities requiring no great

physical exertion. There was no union between the ends of the fractured ribs as might be expected and inspiration still caused considerable retraction of the sternum but the patient apparently experienced no discomfort.

A follow up examination on January 22, 1925 showed her to be in good health. There was no conspicuous deformity of the chest although the line of fractured ribs could be felt apparently united by bony union. The sternum was somewhat flattened and there was a tendency to round shoulders. Her vital capacity was 2,342 cubic centimeters. Figuring from her surface area (weight 34.2 kilograms, surface area 1.17 square meters, Benedict and Tallbot) this is very close to normal according to the tables of vital capacity in children given by Wilson and Edwards (2).

If we assume that her vital capacity before the accident was 2,000 cubic centimeters there was a marked reduction during convalescence. It could not be determined shortly after the accident for obvious reasons although it was clearly just sufficient to maintain life with great physical exertion. On the seventh day, July 24, when neither normal nor deep respiration caused apparent discomfort measurements showed

Respiratory rate	29
Minute volume	7.4 liters
Amplitude	254 cubic centimeters
Vital capacity	553 cubic centimeters

On the fourteenth day, July 31, she showed

Respiratory rate	20
Minute volume	5.15 liters
Amplitude	252 cubic centimeters
Vital capacity	56 cubic centimeters

These capacities represent roughly 28 and 35 per cent of normal.

There were two outstanding problems in this case. The first with which we are less concerned here was that of combating shock. The second was that of attempting to readjust a badly crippled respiratory mechanism. It was at once obvious that the patient was suffering from a severe degree of anoxæmia caused by a subnormal respiratory exchange. Likewise the cause of the decreased respiratory exchange was obvious. The chest was no longer a cavity with firm walls. Inspiration caused a depression of the thoracic walls rather than a negative pressure within the lungs. Although the fracture resulted in complete separation of ribs on the left only the flexibility of the sternum and ribs was so great that the right side of the chest wall could not be effectively expanded. The age of the patient was no doubt a large factor in the extreme mobility of the sternum. In an adult with completely ossified sternum and stiffer ribs it is doubtful whether the mobility of the sternum would be sufficient to interfere dangerously with respiration *per se* even with nearly complete separation of the ribs from it on one side although a bilateral injury might produce a similar condition. Under the conditions present following this accident the pulmonary ventilation was barely sufficient to keep the patient

alive. The use of oxygen was clearly indicated but it was doubtful whether this alone would be adequate to maintain respiration. Accordingly an attempt to fix the sternum was logical.

By the technique used in this instance the application of hooks to the sternum for the purpose of fixation must be clearly recognized as a dangerous procedure. Any puncture of the pleura causing pneumothorax under these conditions would undoubtedly be fatal. This might readily occur either at the time of application or by accidental pressure downward on the forceps at a later period. While the technique employed seemed at the time the obvious way to meet the condition it is unnecessary to run the risk of pleural puncture. As an emergency measure it would appear from the results in this case to be sufficient to grasp the skin and subcutaneous tissues over the sternum firmly with the forceps and make traction on this area. In this way we believe sufficient pull could be given during the period of reaction from shock. More certain traction without danger of pneumothorax could be obtained for a short time by making two small drill holes a short distance apart in the median vertical line of the sternum and engaging the forceps in the cancellous bone through these holes. Only the outer cortical tissue of the sternum needs to be perforated. While this can readily be done on the cadaver in practice the mobile sternum would have to be fixed with a sharp hook so that sufficient pressure to make the drill bite could be exerted. If the drill holes are placed opposite the second and third intercostal spaces they would ordinarily enter bone developed from the second center of ossification of the sternum except in very young children in whom a single hook pushed into the soft sternum will get sufficient resistance from the periosteum and pre-sternal fascia.

Traction on the sternum is suggested only as a means of combating anoxæmia due to crushing injuries causing increased mobility of the thoracic wall. Secondly through reduction of the anoxæmia diminution in the muscular effort needed for respiration and through aiding venous return to the heart by increasing the negative pressure in the great intrathoracic veins the degree of shock may be lessened. Although correction of the deformity may be secured in this way traction is not suggested for this purpose and should be abandoned as soon as the pulmonary ventilation becomes sufficient. As shown in this case a considerable deformity may be of no permanent importance. The technique used in this instance is too dangerous to recommend on account of the

possibility of pneumothorax. The principle employed however is believed to be sound although crushing injuries of the thorax needing fixation of the sternum to promote respiratory exchange are likely to be extremely rare.

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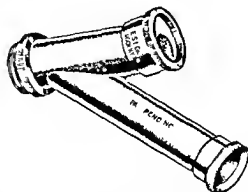
## AN OBSERVERSCOPE FOR PROCTOSCOPY<sup>1</sup>

By LOUIS A. BUIE, M.D., ROCHESTER, MINNESOTA

See Proc Int Med Cong 1923

In no field is the physician less satisfactorily prepared than in that of rectal diseases. An astonishing percentage of physicians have never seen a normal rectum. There are several reasons for this: (1) the inherent antipathy of both patient and physician to any consideration of a rectal disorder; (2) the idea that the examination is disagreeable; and (3) the shrinking of patients from being clinical subjects and many such so-called obstacles.

We have had great difficulty in the past in demonstrating lesions within the rectum and sigmoid. When one locates a lesion and looks away long enough to permit a second person to see it is difficult not only to give an accurate description but to keep the proctoscope directed accurately. A deep breath, a cough, or the slightest movement of the proctoscope carries the object out of the field of vision. It is believed therefore that in perfecting this observerscope (Figure 1) a need has been fulfilled. The device<sup>2</sup> which consists of two eye pieces permits two persons to view the same area in the rectum at the



The observerscope consisting of two eye pieces to be attached to a proctoscope which enables two persons to inspect the same field in the rectum at the same time.

same time so there is no danger that the field of vision will be different for the two observers. The instrument is recommended chiefly to physicians who are engaged in teaching proctology and to those engaged in general work. It can be made to fit the inflating attachment of any proctoscope.

This instrument may be obtained from the Electro-Surgical Institute, 1015 Broadway, New York City.

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# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.  
ALLEN B. KANAVEL, M.D.

Managing Editor  
Associate Editor

WILLIAM J. MAYO, M.D.

Chief of Editorial Staff

FEBRUARY 1926

### ACCIDENT AND INDUSTRIAL SURGERY

PROGRESS and advancement in human endeavor and achievement have been accomplished only when the necessity for improvement is recognized and plans devised to bring a change. Many years ago the surgical profession realized the need for better diagnostic methods, a better knowledge of surgical pathology and better technique in the application of surgical therapy. As a result of this understanding elective surgery has made great strides in the application of all the principles involved in this branch of the art. Thus progress and advancement have been due in a large part to the efficient work that has been accomplished in the large clinics and clinical centers throughout the country where a vast number of cases could be studied and where an opportunity has been afforded for clinical observation, scientific investigation and research and for ascertaining accurately the end results in this extensive clinical material.

We may point with pride to this accomplishment. However the intensive study has been confined almost exclusively to elective

surgery, and the field of accident and industrial surgery has been sadly neglected for it is doubtful if there has been any material reduction in the mortality and morbidity in this class of cases during the past twenty years or since the firm establishment of aseptic and antiseptic surgery.

If this broad statement needs evidence to sustain it, analyze the fractures cared for in the larger institutions of our city and it will be found that the end results in these cases both from an anatomical and functional view leave much to be desired and are probably no better than they were 20 years ago.

A committee was appointed by the American Surgical Association to investigate the results from our present methods of treating fractures. This committee made an exhaustive and comprehensive study of the situation and their report would seem to show the urgent necessity for some radical improvement in our methods of treating this common and serious condition which so often leads to permanent deformity and limitation of function.

Granting that the assumption is true that there is a great need for the betterment of our applied surgical therapy in the care of traumatic injuries, how can this be accomplished?

Reasoning from analogy based on an analysis of the situation prevailing in the field of elective surgery it is a fair conclusion that much could be achieved from a centralization and segregation of injury cases permitting the collection of a large enough number in one place to allow for an intensive study and investigation to be made of all angles of the problem.

As the situation is at the present time no single man or group of men has the opportunity of seeing and studying a sufficiently large number of cases under the most favorable circumstances for intensive investigation. The observation of a large number of one class of cases stimulates thought and interest and research in such a way as to promote better methods of treatment.

In some of our large hospitals arrangements have been perfected whereby patients suffering with a given pathological condition have been segregated and grouped under one surgical chief and it may be pointed out that with this plan in operation the progress in the better understanding of all phases of that particular affliction has been most satisfactory.

The factors which influence this advancement in knowledge are obvious. If we remember the lessons learned in the war it is true but true that the surgeons actively engaged in the care of the wounded improved their methods and became more efficient when the cases of a given injury were segregated and centralized. This afforded an opportunity to appoint the experienced, the specialized and the best equipped surgeon to care for a particular class of cases.

The British and French Medical Corps evolved a system for the centralization of fractures during the year 1917 and from that time the improvement in their end results was most gratifying.

A survey of the situation in that branch of surgery known as industrial surgery in America would indicate that the circumstances surrounding the care of a large proportion of injured patients are influenced by the business methods of the insurance companies carrying the financial risks of the various corporations and building contractors. Some of these companies in their endeavor to minimize the financial outlay have employed the

younger and less experienced surgeons and there has been little or no concerted effort made to improve the methods in the care and treatment of the injured.

Surgeons must come to feel keenly their responsibility in this department of the surgical art. It needs no wordy brief of profound argument to justify the conclusion that the present methods of caring for the injured are a great economic waste when the increased number of days of immediate disability and the more or less permanent disability that may occur is considered.

It would appear that the surgeons of America must be made to feel it their unalterable duty to study the problem from all its angles and in the broadest perspective and to devise some ethical and practical working plan to improve the present situation. True, much has already been accomplished and yet the efforts of the few have not been crowned with unqualified success.

A campaign of education must be inaugurated which will stimulate a broad interest in this all important subject which seems to have attracted surprisingly small attention as compared with the thought, discussion and teaching devoted to elective surgery.

Such propaganda for enlightenment must originate in the larger surgical societies throughout the country and must be made broad enough to reach the industrial insurance companies. The logic must be such as to appeal to their sense of the economic advantage that must necessarily accrue to them in the better care of the injured patient and in consequence the lessening of the number of days of disability.

It may be pointed out in this connection that the large Labor Organizations are cognizant of the necessity for improvement in the care of the men injured in industrial pursuits and in some States have considered the ad-

visability of proposing and supporting some form of state medicine is a remedy.

The thinker of the medical profession recognizes the fallacy of such a proposition and must take steps to forestall such a movement.

FREDERIC A. BESLEY

## EXTRAPLEURAL THORACOPLASTY

**T**UBERCULOSIS 'the great white plague' which a century ago out of each 100,000 people claimed its 300 victims today in city and country districts has a mortality of only 100 in each 100,000 while some crowded cities have cut this rate to from 40 to 60 per 100,000.

Numerous observers have noted that many factors enter into this reduction of the death rate that the white races are becoming more resistant to tubercle bacilli in other words are becoming tuberculized.

We know that this disease is no respecter of races. The Chinese even under the worst possible conditions of overcrowding sanitation and hygiene show no greater mortality tables than do the Caucasians probably their greater age as a race and their longer exposure to infection having built up their resistance in spite of adverse living conditions. It is well known how vulnerable are the red and black races to this disease. Its ravages among the American Indians free from tuberculosis until contaminated by the white carriers are a matter of history. Bushnell has dramatically told how the natives of the Marquesas reacted to the disease carried to them from an older civilization.

Robert Louis Stevenson tells how whole tribes in the short span of or 3 years were decimated by it. He cites one instance in which the tribe of Hapaa 300 strong was reduced to 2 survivors in less than a year after contamination by tuberculosis.

Autopsy statistics among the white races show that from 85 to 90 per cent of all persons coming to the pathologist's table exhibit evidences of having been inoculated with tuberculosis which has either failed to progress or has been overcome a real tuberculization of the hosts.

Twenty years ago tuberculous infection of the cervical glands was common now it is extremely rare. Bovine tuberculosis especially in children finds its portal of entry in the tonsils or the pharyngeal region and manifests itself early in the lymph glands of the neck probably the now admitted infrequency of this disease is due to the testing of herds for tuberculosis thus and the pasteurization of milk destroying the menace from that greatest of carriers of bovine tuberculosis.

While the tuberculization of the race the adoption of methods which minimize the danger from bovine tuberculosis and a better understanding of how to combat the disease has tremendously lowered its mortality, still its very omnipresence and the admitted mortality of 100 to each 100,000 people makes it a very real menace to society even so slowly but steadily progress has been made which offers hope of comfort and cure to the consumptive.

When the profession recognized and accepted the fact that rest good food and pure air formed the tripod upon which was based the cure of tuberculosis they made real strides toward conquering the disease.

Superimposed upon this tripod came the Rollier of heliotherapy treatment. Then as a further expression of rest we were given artificial pneumothorax which by the introduction of gas or air into the pleural cavity collapsed the lung and gave that diseased organ real physiological rest.

This treatment marked another milestone in the fight against the disease and helped

crowd still higher the steadily mounting curve which marked the incidence of cures

While artificial pneumothorax is a therapeutic agent of great value yet there remains about 20 per cent of the cases in which it is indicated but cannot be used. These are cases of advanced unilateral pulmonary tuberculosis in which synechia between the visceral and parietal pleura hold the lung expanded and prevent its collapse by air under pressure, cases which because of failure of this procedure are doomed to swell the mortality tables, which show that approximately two thirds of these cases die early, whereas of those which have been successfully collapsed 66 per cent recover.

When there is failure of collapse after repeated attempts at artificial pneumothorax then only should the formidable operation of extrapleural thoracoplasty be considered. This operation is indicated only in the advanced cases of unilateral pulmonary tuberculosis where the other lung is healthy, slightly involved or exhibits healed tuberculosis. This operation as it was finally standardized by Brauer, Frederick and Sauerbruch and performed today consists of a long sickle shaped paravertebral incision, beginning at the root of the neck, parallels the spine above and swings out over the tenth rib below, subperiosteally, from 2 to 15 centimeters of all the ribs except the twelfth are removed. The evolution of the operation showed better collapse of the lung was obtained when the ribs were resected close to the spine behind for the more mobile costal margins of the anterior

ribs readily collapse with the collapse of the lung. This operation although done in one stage by many European surgeons has a lower mortality when done in two stages.

An interval of but 2 or 3 weeks between the two stages is dictated because of the rapid reformation of new ribs from the periosteum which has been conserved. These newly formed ribs tend to hold out the collapsed lung and defeat the object of the operation. This operation can be done entirely under local anesthesia but by preference should be done under local anesthesia supplemented by gas oxygen analgesia.

By its very magnitude and from the fact that it is performed upon people who are already ill and depleted by the ravages of their disease this operation must of necessity carry heavy primary mortality within the first month. In the hands of all operators this mortality is approximately from 10 to 15 per cent yet when we stop to consider that almost all of these people are doomed without surgical relief we believe the hazard of this mortality must be accepted. No case should be subjected to extrapleural thoracoplasty until it has been under the extended observation of an experienced medical specialist in tuberculosis.

Studying reports of 1024 operations Alexander found that there were 32 per cent of cures and 26 per cent of marked improvement shown. Considering that these people cannot recover without surgery this is ample argument for the operation of extrapleural thoracoplasty.

A. A. LAW

# MASTER SURGEONS OF AMERICA

## PHINEAS SANBORN CONNER

**M**Y INTRODUCTION to Phineas Sanborn Conner II occurred at 6 years of age when I was awaking from that deepest sleep which comes from a tumble over the banisters and landing on one's head. Even then the man's personality made a lasting impression. He appeared as a giant with a beak of a nose and a great long bristling moustache. He was bolding my arm but he did not hurt. His big hands were firm and tender. His voice was gruff and big but kind. Out of his eyes came the look of a friend. He was a giant but not the story book kind, and in my child's mind I quickly sensed the something in this personality that took from the beak nose, the firm set mouth, the bristling moustache, those story book attributes.

Phineas Sanborn Conner, Jr., A.B., A.M., M.D., LL.D., was born in West Chester, Pennsylvania, August 23, 1839. His father was a practicing physician of modest retiring disposition, well informed but loath to display publicly his ability. The mother, Elizabeth Angelina Fair Prichard Hook Sanborn Conner, was an energetic scholarly woman who greatly influenced the molding of her son's character. Doctor Conner's ancestral tree is an illustrious one and contains the names of "Father" Bachler, who landed in Boston Harbor in 1632, Daniel Webster, Justine Smith Merrill, Seth Low, Nathaniel Hawthorne and John Greenleaf Whittier. The last describes the 'Bachler eye' as brilliant, keen, piercing, penetrating. Such eyes had Doctor Conner.

The Conner family moved to Cincinnati in 1844. In 1859, after an education obtained in the Cincinnati schools, he was graduated from Dartmouth College. Returning to Cincinnati, he attended lectures at the Medical College of Ohio, session 1859-1860, then at Jefferson Medical College, from which he was graduated in March, 1861. During these college years, he spent some time as apothecary and acting physician in a Connecticut hospital for the insane, and about six months in doing what was then termed "walking the hospitals" in New York City. In November, 1861, he responded to the Union call. In August, 1866, the war over, he resigned and came home, having been brevetted major for "gallant actions and meritorious services." His teaching career began at once with the professorship of surgery in the Cincinnati College of Medicine and Surgery, at the age of 27. This was followed in rapid succession by other professional appointments in the Medical College of Ohio, culminating in the professorship of surgery



PHINEAS S CONYER  
1839-1909



in 1887 For 24 years he was professor of surgery in the Dartmouth Medical School

It was nearly 15 years before Doctor Conner had a remunerative private practice These were years of character building In the library of his old home in Cincinnati, he surrounded himself with his heroes Vesalius Harvey, Pare, and Sir John Hunter These he studied and their ideas became his, thus crystallizing his character

The early opportunities presented to Doctor Conner so broadened his experience and clarified his vision that he was enabled to find the solution of many problems He belonged to a generation of men who of necessity, developed keen powers of observation With a history of the case and their highly trained special senses they accomplished wonders in arriving at a correct opinion He was often heard to say that the X ray machine was beginning to have a bad effect because its 'short cut methods' undermined one's ability to observe Probably the essence of his power lay in his ability to concentrate on the vital factors of any problem and to disregard unessential details As a diagnostician he was of the best and many times showed an intuition that appeared fairly uncanny On one occasion when talking to him of this faculty he said 'Intuition sir is subconscious reasoning based on previous experience'

Next to his family and friends, the medical college medical education and teaching were his greatest interests As a teacher, all agree regarding his unusual ability but one criticism might be made that he lectured on a plane above the capacity of his students He used the didactic method with little of demonstration to illustrate This method perhaps was a fault of the times as the then customary two short school years to an M D degree gave but little opportunity for practical laboratory or bedside work He was most stimulating as a teacher, not only because of his knowledge of his specialty, but because in his lectures the students had the advantage of his broad education in all the collateral branches of learning Perhaps his best work as a teacher of surgery was done in the amphitheaters of the old Cincinnati General and Good Samaritan Hospitals

Doctor Conner, in an address at the opening of the New Medical Hall of Jefferson Medical College Philadelphia in 1899 gave his idea of medical teaching as follows

The logical condensed lucid presentation in lecture form of the summation of the wisdom of the past the science of the present as they have become a part of the accomplished scholar the dextrous experimenter the experienced practitioner given in language terse lucid graceful if it may be, is far more impressive far more instructive far more effective than the study of any textbook'

From the Historical Address made at the Centennial exercises of the Medical Department of Dartmouth College in 1897 these sentences are taken But the knowing is only one side and that the lesser of medicine, there is also



the doing and the art must be cultivated even more than the science. The great end and aim of medical education is to make not scholars not scientists, but healers of the sick.

Surgically Doctor Conner's greatest contribution to the sum total of world accomplishment was his demonstration in 1883 at the Good Samaritan Hospital Cincinnati that the complete removal of the human stomach was feasible. A great deal of his work was original and of a daring pioneer type much of it showed a recognition of the advances made by others and the choosing of the good points from their work. As a surgeon he was alert cool, practical. Whenever he appeared in the operating arena it was as the central figure. Precise in touch supple in movement he added the polish of the finished artist to the nonchalance of the experienced operator. Doctor Conner had an individuality that stood out at all times in bold relief neither conventional nor stencil made. His was an intense nature with the supremely confident air of the born chieftain.

It has been said that his military training was a large factor in producing an outward appearance of rough severity brusqueness and irritability which to some made him unapproachable and forbidding. Rather might not these characteristics be attributed to the long and rough road he traveled in the early years of his professional life and an added veneer he assumed to cover a sensitive warm heartedness not compatible with the requirements of the surgery of the pre-anæsthetic era? He was not much given to evaluating men publicly unless aroused to anger and then he spoke in no easily mistaken words. Someone has said "The asperities of Doctor Conner's character were an indication of his strength." This combined with his peculiar eagle eyes made a personality from which the timid usually shrank. The truth whatever it may have been, was the strongest card with which to win his friendship. His attitude toward people at large was so in contrast to his attitude toward his close friends and his family that one can almost truthfully say his was a dual personality. To the one stern sharp quick, gruff austere and overbearing to the latter gentle considerate companionable and devoted.

The spoken word moves at the time and influences for the season but the written words remain. Few men have written more voluminously and better than did Doctor Conner. His contributions of written words that remain are almost innumerable and these can be found closely scattered through the medical literature of the times. The subjects of these contributions practically cover the entire field of surgery as then understood. He was associate editor of at least three surgical textbooks. He was honored by being called upon to give addresses at many national and local affairs.

Besides the army rank early obtained and the later medical college positions held Doctor Conner was president of the Cincinnati Academy of Medicine Ohio State Medical Association the American Academy of Medicine and the Ameri-

can Surgical Association. At the close of the Spanish War, President McKinley appointed him to serve on the examining board investigating the conduct of the war, this service necessitated the abandonment for months of his private practice. He was a member of the Loyal Legion Sons of the American Revolution and of Colonial Wars. The title of LL.D. was conferred by Dartmouth in 1884.

Doctor Conner was married in December, 1873, to Julia E. Johnston of Cincinnati and his devotion to this woman was ideal. Three children were born to them. It was a revelation to see him in his home. Hard as it may be for his casual acquaintance to believe it, there is ample proof that Doctor Conner loved a joke for the joke's sake, and was full of fun and quiet wit. He once said about children:

'What with the plague of their living and the fear of their dying there's no fun in them.' All day long he would go about his business like a storm cloud, but the minute he passed the threshold of his home a smile lighted his face. He became apparently the youngest member of the family, no longer the ruler but the ruled. All this following a day of impetuous driving work, when assistants, internes, nurses feared him and bowed to him as a strict disciplinarian. His love of home and family was intense and to his wife he was the essence of chivalry. The death of Mrs. Conner in 1899 was the beginning of a break from which he never completely recovered. Doctor Conner died just as he wished suddenly and without warning March 6, 1909.

A word picture of Doctor Conner cannot be better completed than to quote a few remarks made by him over thirty years ago in one of his valedictory addresses to the students of the old Medical College of Ohio which undoubtedly express the rule of life by which he lived:

'Whichever you may go, whatever you may do, be earnest, be honest, be faithful and hopeful. The life of the physician demands the exercise of the highest qualities of mind and heart. If you would live it aright, be studious, be thoughtful, judicious, watchful. It carries with it grave responsibilities, it brings with it full rewards. There is in it labor and cares and anxieties, there comes from it the enduring satisfaction of beneficent work well done. It teaches us to be considerate, charitable, humane. It opens to us the brightest and the darkest chapters in a man's history. It reveals the heights of human affection, it lays bare the very depths of human depravity. There is nothing in life that it does not acquaint us with. From now on until the great change comes to each of you, it will have no beginning, it will have no end. Days and nights and times and seasons are as if they were not, for the doctor is always on duty. In the thick of the fight or waiting orders with the reserves, guarding the outpost or leading a forlorn hope, he is ever full armed. As the occupation is a constant one, so must the preparation for it be a constant one. Mind and body must be kept in the best possible order. Sobriety and studiousness must characterize the life. In our own country we now seem to be approaching a point at which a choice of way must be made. The commercial spirit of the age is influencing all persons affecting every occupation. Medicine must either receive it and direct it, and secure from

it its inherent good or must go over to it, be absorbed in it be lost in a mere trade and that a degraded and degrading one In the tricks of the charlatan there is nothing new finding medical idols with feet of clay is nothing strange The threatening feature of the day is the widespreading of a spirit in the air that would infect the medical world with the germs of an all grasping greed and uncontrolled ambition that makes the highest good of medicine the acquisition of money and the praise of the people Do not mistake The duty of each one of us today, is as it has ever been to work in this our vocation and art truly rightly and without deceit so that it may be to the glory of God to the common weal and our further knowledge and finally to the health and safeguard of the people I feel you have received is freely give'

DUDLEY WHITE PALMER





# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

BY ALFRED J. BROWN, M.D., F.A.C.S., OMAHA, NEBRASKA

### THE OBSTETRICS BOOKLET OF RUEFF

THE practice of obstetrics in the early part of the sixteenth century had not kept pace with other medical branches and was still in the hands of ignorant midwives and charlatans. Eucharius Roeslin had done his bit to try to raise its standards with his *Rosegarden*, but though the volume passed through many editions little was accomplished. The time was ripe therefore for a new book on obstetrics. This was seized upon at only a few years interval by two men in two countries. The first of these was Jacob Rueff of Zurich, Switzerland, who in 1554 published *A very cheerful book let of encouragement of the conception and birth of men and its frequent accidents and hindrances etc.* at Zurich and a second edition appeared in 1559. Why the volume should have been called *cheerful* it is hard to understand as it is any thing but that but there the title stands. *Ein schon lustig Trost buchle* etc. An edition printed in Latin appeared the same year 1554 in which the title reads: *Concerning the conception and generation of man etc.* Shortly after the author's death in 1558 the incongruity of the German title was apparently recognized and the book was reprinted at Frankfurt a. M. in 1580 under the title *Midwives Book from which one might all the secrets of the female sex etc.* The book remained extant for over a hundred years the last edition being printed at Amsterdam, Holland in 1670. The volume I examined is one of the Latin editions printed at Frankfurt in 1587.

When one reviews Rueff's life and his manifold activities one at first wonders why he happened to write a work on obstetrics but looking the book over carefully seems to answer the question. Where he was born is in doubt, some authorities say in the Rhynthal others in Wuertemberg. When he was born is unknown as is also the date when he came to Zurich and settled there. He was prominent in many fields. He wrote astronomical notes for an almanac and furnished the tables for blood letting. He was a popular poet and folksong writer. He was also a great enthusiast for religious freedom so much so that he served twice (1529, 1531) with the troops of Zurich against the Catholic cantons. He was likewise a dramatic writer and in 1535 his play *Hiob* was produced and in 1545 his *Wilhelm Tell*. He seems also to have been well known in medicine in

Zurich at least for in the almanac he is described as surgeon and lithotomist of Zurich. In addition to his obstetrics he wrote a little book of 59 pages on tumors which was published in Frankfurt in 1556 and republished in Amsterdam in 1648 and 1662.

The book follows the *Rosegarden* fairly closely. Additions are made as Rueff advises cephalic in addition to podalic version and describes its performance in detail. He advises and illustrates both toothed and smooth forceps for the extraction of the dead fetus but does not advise their use on the living child though the smooth forceps (see illustration) look as if they could have been used for at least a low forceps delivery. The various types of abnormal positions of the fetus *in utero* (some of them imaginary) are illustrated and serve to show that the author knew the commoner malpositions.

It is in that portion of the book devoted to monsters that it seems to me his desire to write the book crops out. When we remember the man was a religious zealot here was his opportunity to apply this phase of his character to medicine. At this time the theory that the devil worked his will on pregnant women was rife. The great Luther himself believed that the devil substituted changelings for normal children and gave the signs by which they might be recognized. But more than that these changelings and monsters came as the punishment for sin. So Rueff devotes ten pages of his book to their illustration and description. How better could he help to save the people from sin than to give the backing of science to the penalties of religious error? He illustrates first the intra uterine amputations authentic without doubt. Then double headed and double bodied adults and infants. Siamese twin anomalies the remains of fetal inclusions such as a head protruding from the abdomen then club hands club feet and double hands. So he takes in fairly well the range of possibilities. But then he leaves the possible and goes to the changeling and describes and illustrates instances of infants with claw hands and feet eyes in the abdomen and extremities animal heads protruding from the joints infants with animal heads (even one with an elephant head) and finally as a climax an infant with a horn wings and the sign of the cross surmounted with upslon on its breast. There were also other abnormalities but the interesting point is that to each he gives an interpretation on a religious basis. Was his desire to bring this material forward the reason for his writing the book?



To discuss whether or not all these suggestions are feasible or applicable to our own conditions is beyond the scope of a review. The study of this pamphlet however must be warmly recommended to any sociologically minded physician.

I AM not equally positive about the book by Rout.<sup>1</sup> In fact I was so afraid lest I might not do justice to it that I asked a friend of mine to review it for the readers of this journal. Her comment follows.

*The Morality of Birth Control* is an enthusiastic and feminine revelation of this perplexing question. In thirteen chapters and an appendix Mrs. Rout presents the subject hygienically and at times somewhat hysterically, inasmuch as she establishes for her thesis the hypothesis that mankind's capacity for improvement is at present locked up in the bodies of womankind. The means for its release is the natural constructive chastity of enlightened free and independent womanhood. Toward that goal the first step is the education of young unmarried women as to the physical basis of marriage and the meaning of marriage for the existence and evolution of the race. The second step is the education of young wives to the control of their own fertility so that there may be no unwilling maternity. Then and not till then the evolution of man will be resumed. The individual happiness of romantic lovers will not be interfered with. At present women are not the mothers of the race; they are each individually the private property of some individual man. Once they are released from this bondage made socially and economically free their natural chastity will make them faithful to the men they love. Virtue will be enthroned and the race will evolve. All this however with the universal use of contraceptives.<sup>2</sup>

It is very evident from the above that Mrs. Rout's experience as a law court reporter and social worker has somewhat prejudiced her judgment as a married woman which she now is. Consequently throughout her book she is polemical rather than practical, sentimental rather than scientific. However she is always amusing and interesting. Her humor is prolific. For instance she says: Total abstinence from sexual intercourse may be said to be the only absolutely certain 100 per cent fool proof form of birth control. Again Abstinence has no more and no less value in the cultivation of sound ethics than starvation has in the cultivation of sound digestion.

Birth control is no a modern invention. Mrs. Rout says it is thousands of years old older than the Bible in which control must have been employed because we find frequent exhortations to increase and multiply. She insinuates that both the state and the church unconsciously practice birth control. The state in its regulatory laws for marriage and divorce the church in its definition and insistence

upon chastity and its imposition of celibacy upon millions of nuns and priests. War and society practice it in many ways but specially in condemning the surplus women to perpetual virginity. Mrs. Rout traces the gradual rise of sex ethics through the evolution of our domestic departments such as the cave harem and home. She shows how social ethics have graduated from infanticide and feticide to prevention by means of contraceptives. However race improvement is a positive not a negative process. It is not enough to destroy or prevent the birth of the unfit but it is necessary to produce the fit through selection or eugenics and the careful spacing of births. And finally Mrs. Rout establishes the hope of the future of the race upon the natural chastity and monogamous instinct of women.

Being a woman myself I must confess that I am both startled and flattered by Mrs. Rout's naive and original book which I recommend as entertainment to the wise and propaganda to the unenlightened.<sup>3</sup>

**PUBIOTOMY** and symphyseotomy are much more in vogue in France than in most other countries. These operations formed the official subject for discussion at this year's meeting of the French Gynecological Society and the transactions indicate that their popularity remains undiminished. The cervical cesarean section which has supplanted these operations in Germany and is gaining ground both in this country and in England has not found much favor in France. Another rival however has risen in the form of the exteriorization operation of Portes of Paris. The steps of this novel and interesting procedure are briefly as follows. The pregnant uterus is lifted out of the abdominal wound and the latter is quickly closed behind it. The uterus is then incised the child extracted and the uterine incision sutured. The uterus remains outside of the abdomen for several weeks protected of course by suitable dressings until involution is complete when the abdominal wound is again opened and the uterus restored into the pelvic cavity. In a recent inaugural thesis Scemla<sup>2</sup> endeavors a comparison between the Portes operation and the operative enlargement of the bony pelvis. He enumerates the indications for the two methods of delivery describes their technique illustrates his contentions with case reports and finally draws a parallel between these procedures. Inasmuch as pubiotomies date back 30 years and the exteriorization operation is barely two years of age and numbers only seventeen observations such a comparison strikes me as somewhat premature. As it is the author aims at the conclusion that in cases of contracted pelvis with or without infection pubiotomy is distinctly superior to the operation devised by Portes.

<sup>1</sup>THE MORALITY OF BIRTH CONTROL, by Ethel A. Rout, London, J. B. Lane, the Bodley Head, Ltd. 1924. 6 s.

<sup>2</sup>DISCOURS SUR LES PÉRIODIQUES DES PÉLVIOTOMIES ET DE LA CÉSARÉOTOMIE, par JULES SCÉMILA, THÈSE POUR LE DOCTORAT EN MÉDECINE, 1924. 100 pages. 10 fr. 50.



W<sup>L</sup> want to give Fulkerson credit for the idea of writing a book on gynecological urology the first I believe, in American literature! The interrelationship of genital and urinary tracts, so intimate and reciprocal influences of pathological conditions in the two systems are so frequent that a special treatise on this subject would be decidedly welcome. In such a book one would naturally expect to read something of the author's views on the importance of cystoscopy in determining the operability of cervical cancer on the therapy of vesical irritation following uterine radium treatment on the serious effect of pyelitis on the outcome of gynecological or obstetrical operations on modern views regarding the etiology of pyelitis in pregnancy and the prevention of recurrences on the evolution of surgical treatment of incontinence of the bladder from Kelly's urethrorrhaphy to the pyramidalis operation of Stoeckel on the ureter in prolapse of the uterus. But of all these and other special problems which concern the gynecologist in the study and treatment of urinary affections not a word is said in Fulkerson's book. Instead we read perhaps in amplified fashion what is usually found in books on male genito urinary diseases and a good deal about nephrotomies and pyelotomies nephrectomies and cystectomies and other procedures which are plainly outside our scope and equally plainly belong to the domain of the specialist in urology. The bibliography is largely limited to contributions in domestic journals of the last 3 or 4 years. Yet gynecological urology as a subdivision of gynecology is more than 20 years of age and if the author had not almost altogether excluded foreign references he might have found valuable material to incorporate in his book.

In its present form the book represents urology in women rather than gynecological urology which means something entirely different. Yet the original idea is much too good to be abandoned and we hope that the author by a thorough revision will make his book more serviceable to gynecologists and all those who treat urinary affections in women.

B<sup>y</sup> diseases of ovulation Dalche<sup>2</sup> understands all the phenomena which result from disturbances in the evolution of the egg cell from its primordial state to its maturity and of the follicle from its first appearance to its rupture. Our anatomical knowledge of the conditions involved is very meager hardly that experimental parthenogenesis the effect of X rays and radium on animal and human ovaries and observations made on the offspring of radiated mothers permit us to assume the action of chemical physical and mechanical irritations. For the most part the causes of the diseases of ovulation must be sought in heredity or early infancy. Thus tuberculosis syphilis alcoholism lead poison

ing advanced age of the parents acute infectious diseases fatigue and undernourishment of the child may account for a weakening of the ovaries. Clinically this debility of the ovaries manifests itself in various definite syndromes which are grouped under the heads of infecundity amenorrhea and dysmenorrhea and receive detailed consideration in separate chapters. Yet another clinical entity is that of menstrual ovaritis to which the closing chapter of the monograph is devoted. The author finds it somewhat difficult to suggest a precise definition of this form and proposes to call it an ovaritis due to defective ovulation an *ovaritis o i gene*. Considering the fact that ovaritis implies an inflammatory process it seems to me that we may accept this definition only for want of a better word provided we bear in mind that non infectious causes and even accidental factors such as traumatism emotional shock chilling etc may produce the condition in question. The symptoms complications prognosis diagnosis and treatment are fully discussed in each chapter.

What Dalche says is always well worth hearing. In his late publication he has given us a fluently written exceedingly interesting and important chapter of medical gynecology which distinctly merits serious consideration.

T<sup>HE</sup> systematic campaign against cancer which was initiated by the gynecologist Winter in Germany and spread over a large part of the civilized world has led in this country to the formation of the American Society for the Control of Cancer and to the founding of special hospitals for the study and treatment of cancer such as the Barnard Free Skin and Cancer Hospital in St. Louis the Memorial Hospital in New York and the Huntington Memorial in Boston. And now a colleague in far away Brazil has taken up the work in his country. Moa jardino<sup>3</sup> of Rio de Janeiro endeavors by his monograph of 243 pages to arouse the interest of the profession in early diagnosis and prophylaxis of cancer. This disease is steadily increasing in Brazil though it is not as common as in other countries. This relative paucity disproves incidentally the claim of Bulkley that the abuse of coffee is one of the causes of cancer. For among Brazilians the use of coffee is a vice rather than a mere habit. Parenthetically I would add that the yearly increase, as in other countries probably due to improved diagnosis. After giving a brief historical sketch of our knowledge and the numerous theories concerning the nature of cancer the author proceeds to a detailed exposition of the ways and means adopted in various countries to stem the progress of the scourge. We learn from this chapter that in Brazil attempts in this direction date back to 1904 but that they have remained sporadic. Recently however several radiological institutions have been founded or are in

Mr. L. G. Urology By Ly Lyl I R 3 AB MD  
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process of construction and a slowly accumulating medical literature bears testimony to the fact that the importance of the subject is permeating wider circles. A separate chapter is devoted to cancer of the uterus in particular. The section on pathology which is very well presented would have been improved by a few well chosen pictures but there are no illustrations whatever in the monograph except a reproduction on the title page of the cancer of Ambrósio Pare, the crab with claws and long legs. As to treatment the value of surgery is dwelt upon rather briefly radiotherapy is emphasized though it is still too new to permit of definite conclusions as to its efficacy. More emphasis than with us is laid on organotherapy serum and vaccine treatment and hypodermic and internal administration of various metal and biological preparations. It seems to me that in this particular section the author has left the path of actual experience and lost himself in the maze of speculative and unproved remedies. He might have rendered a better service to his compatriots by calling to their attention definitely tested methods of treatment of inoperable cancer of the uterus such for instance as the acetone treatment which now has stood the test of 20 years. The closing chapter contains thoughtful and detailed plans for a national Institute of Cancer and an outline of a nation wide campaign.

We welcome in Monjardino's treatise a new ally in the fight against a relentless foe.

THE fifth edition of Jellett's book<sup>1</sup> has been enlarged by the insertion of sections on tubal insufflation and pneumoperitoneum Sampson's endometrial implants and ovarian transplantation and other new subjects. Even with the additional 200 pages the work holds a happy medium between the all too abbreviated manuals and the bulky tomes of some recent textbook writers. Its makeup is distinctly pleasing paper and type are of the best and the illustrations are numerous and well executed among them there is an unusually large number of colored pictures and plates. The author who now lives in New Zealand has successfully overcome the difficulties imposed by the great distance which separates him from his publishers in London. There can be no doubt as to the author's ability as a teacher. His insistence on pathology both gross and microscopic and the lucidity of his descriptions prove it and I was glad to acknowledge it in a previous review.<sup>2</sup>

At that time I took occasion to mention a few shortcomings and omissions which slightly interfered with the full enjoyment of the reader but these have not been corrected in the present edition. The chapter on vaccine treatment in both editions has been contributed by Dr Rowlette and a comparison of the two brings out the interesting fact that this author has found no reason to change his

views in the past 9 years. Gonococcus vaccine has continued to yield remarkable results in his hand. In gonorrhoea of the vagina and uterus complete cure seems to be the rule though the treatment may consume considerable time. In ascending gonorrhoea of the tubes vaccine if given in time may prevent salpingitis developing into pyosalpinx and thus prevent sterility. Since the vaccine therapy has been disappointing to the great majority of writers the continued success in Rowlette's experience must attract our attention.

A GOOD Spanish textbook of obstetrics looks amazingly much like any American or German textbook as to shape and size arrangement of the subject matter and illustrations. Such at least is the case with the textbook by Recasens<sup>3</sup> which recently appeared in its fifth edition. I have looked through the work largely with a view of discovering wherein Spanish thought and practice in obstetrics differed from ours but I find extremely little to report. This is after all not surprising for Recasens is the recognized leader of our specialty in Spain and the numerous references in the text and the extensive bibliographies at the end of each chapter show that he has kept in closest touch with all developments both in his country and abroad.

It may interest American readers to learn that *me narche* occurs in Southern Spain at 13 years and but one year later in the rest of the peninsula. Recasens prefers the dorsal posture for delivery in contrast to English obstetricians who rather favor the lateral position. Chloroform which he administers by a mask of his own construction is the anesthetic of choice in labor. Lateral episiotomy is preferable to median incision. Conservatism should prevail in the therapy of eclampsia an abdominal cesarean section add another heavy burden to the exhaustion of the organism. Digital pelvimetry of the diagonal conjugate is depicted as being made with the index finger alone. I doubt whether it is possible to reach the promontory in a normally large pelvis with only one finger. Radiopelvimetry is resorted to rather frequently and instructions are given as to how to obtain reliable results. A number of excellent X ray plates both from his own material and from the well known work of Warnekros indicate that the author values X ray photography. In marginal and lateral placenta previa rupture of the membranes version the Champetier bag tamponade etc. are indicated. The maternal mortality ranges between 6 and 20 per cent that of the children between 40 and 60 per cent. Cesarean section is permissible only in the case of central placenta previa if the child is alive.

If we cast a final glance upon the books reviewed in this issue and make note of their birthplaces—Austria Germany England France United States Brazil New Zealand Spain—we must needs be impressed anew with the wide extent of our scientific fatherland which is the world.

<sup>1</sup>AT Once Gy & Obs By J. J. Jellett, M.D. (London) 1911 & K. P. L. S. 2nd. Ed. do J. A. Ch. 1914, 45  
10 12 Gyne. & Obst. 9 7 224, 713

<sup>2</sup>ERA AND P. OBSTETRICS CIA. By Dr. Sebastià Recasens  
Obst. 12 5 4 Gyne. 1 27 etc. 5th ed. Barcelo. S. 1. 1 1

# AMERICAN COLLEGE OF SURGEONS

## THE WIDENING RANGE OF MEDICINE<sup>1</sup>

BY THE RIGHT HON LORD DAWSON OF PENN GCVO KCMG MD LONDON ENGLAND

A DOUBLE honor is my portion tonight—your fellowship and the delivery of this address and let me say how deeply I treasure it. If my expression of gratitude is brief it is out of regard for the many other claims on your attention this evening not forgetting the expectations for tomorrow which possess the minds of all citizens of Philadelphia. I will ask you then to liken my appreciation to the small hand of the clock which though ranging one twelfth of the distance of the long hand signifies twelve times as much.

We have just witnessed a short but moving ceremony the conferring of the Legion of Honour by Dr de Martel upon Dr Charles Mayo. The honor and the services of the recipient are alike unique in distinction. To all of our tongue in whatever land they be this recognition not only of a great mind but of a genius for friendship will bring rejoicing.

In the choice of a subject suitable to this occasion I was influenced by the knowledge that laymen both interested and distinguished would constitute a portion of the audience so it occurred to me to present for your consideration how on the one hand medicine is increasing its contact with the sciences and on the other hand is extending the range of its influence to cognate activities in the body politic.

Medicine has so to speak an outer and an inner temple. In the inner temple searching and thought reign and in the outer action becomes the handmaid of thought.

During the twentieth century progress in its sciences has been so notable that medicine has received fresh direction and inspiration. Thought is vivid new pathways are opening out and the time is instinct with new unfoldings.

And yet we should not forget the debt we owe to the times which have preceded us. It has often been that we have reaped because they have sown and their achievements measure large when the slenderness of their resources is remembered.

And since the spirit of science awoke from its long sleep in the sixteenth century it has been

the proud part of medicine to foster and advance the sciences on which it now increasingly rests.

The dawn was first felt at Padua where Vesalius Gallopius and others of world renown established human anatomy and where Harvey received a measure of that inspiration which gave life to physiology. Let me commend to those who have not yet undertaken it a visit to this ancient seat of learning. Those of us gathered as we were from all countries who met there to celebrate the seven hundredth anniversary of its founding have a treasured memory of an historic pilgrimage to do honor to greatness.

To the early knowledge of physics the medical profession made notable contribution. Gilbert in the sixteenth century Galvani and Young in the seventeenth century stand forth as great discoverers in magnetism electricity and light respectively. They were all three physicians. The identity of the early progress of chemistry with the medical profession was even more close and with biology are associated names such as John Hunter and Richard Owen. Of the total 113 original Fellows of the Royal Society founded in the reign of Charles II 25 were Doctors of Medicine.

It is curious to reflect that side by side with these rich contributions to knowledge by doctors the general practice of medicine was until the nineteenth century fogged by fanciful reasoning and fantastic treatment. It could not shake itself free from habits of thought which had their origin far back in primitive beliefs in magic and hostile deities. And in present times so persistent is tradition the world is still imbued with belief if not in magic yet in the magical, to the detriment of its true interests.

To quote Garrod in his eloquent Harvard oration. The primitive medicine and the art of the medicine man survive to this day among the savage races of the earth and he would be a bold man who should deny their survival among those races which regard themselves as the highest products of civilization. Are any of us wholly free from such ideas?

<sup>1</sup>Fellowship Address delivered at the Thirtieth Convocation of the American College of Surgeons Philadelphia October 5 1915

It is difficult for us to convince the public that we have no wonders to offer except those to be found along the narrow and straight path of rational endeavor and this is especially true in the realm of therapeutics.

We in the profession might set example by a more critical examination of our ways and means. We are apt to forget how many of our remedies and formulæ have descended by apostolic succession from previous generations. In order to illustrate, not what our formulæ are but from what they have descended let me quote you. An excellent Medicine for the Drop is made for Queen Elizabeth by Doctor Adrian and Doctor Lacy.

Take Polipodium Spikanard Squall Ginger Markoram Galungal Setwel of each a penny weight Setwa leaves and cods so much as all the rest grosly beaten put them into a bag and hang it in an earthen pot of two gallons of Ale and every four daies cover the pot with new Barm and drink no other drink for six daies and this shall purge all ill humors out of the body neither will it let the blood putrifie nor flegme to have domination nor Choller to burn nor Melancholly to have exaltation it doth encrease Blood and helpeth all evil it helpeth and purgeth Rheum it defendeth the Stomack, it preserveth the body and engendereth good colour comforts the sight and nourisheth the Mind.

There are features of this prescription which might make it popular today and even in this country.

And yet in that gray light there were glimmers in the sky. For instance digitalis was in the pharmacopœia of 1665. Another example of cycles in knowledge is to be found in the fact that Gairdner recommended iodine for goiter 100 years ago. And that is dwarfed when we learn from Professor Schmidt that an herb Ma Huang containing an active principle similar to adrenalin was sanctioned by the Emperor Shen Nung and used over 5000 years ago.

Of the sciences on which medicine is now firmly founded physiology chemistry and physics stand forth prominently and their growing territories are widening the range of medicine. Chemistry in particular seems to be acquiring increasing contact with the science of the living body and mind and one wonders now that the mysteries of the atom have been penetrated whether in the future physics may not gather physiology and chemistry unto itself. And perhaps one of the reasons why the honor of your choice has this year fallen upon a physician is the recognition on your part that the progress of surgery will

henceforth depend and in increasing measure on co-operation with medicine. Although technique will continue to improve, it will not command the position it has hitherto done. Speaking as a physician who has always been in close association with surgeons I suggest that there is here and there a tendency to overemphasize mechanical aids forgetting that greatness in art is to be found in simplicity. Your thoughts are turning to the study of the tissues and forces of the patient. With you as with the physician the cry is Back to the soil.

The fear of sepsis no longer possesses the surgeon though it still influences his thought. You now rely on studies it may be of liver or pancreatic function of sugar chloride or non proteid nitrogen content of metabolic rates. These help you to understand the problem of each patient, the peculiarities even the perversities of his symptoms and either to prepare him for operation or even excuse him operation or guide him to convalescence. Such co-operation with medicine will bring you results hitherto undreamed of. Is it not possible that biochemistry helps to measure the physical aspect of individuality? In the days when acute infections played so dramatic a part in life and death among peoples when medical men were so largely occupied with their visitation and impressed with their own relative powerlessness to battle against them it was only natural that thought should envisage disease more as an evil force from without and set less value on the qualities belonging to the patient.

The banishment of typhoid and other fevers from our midst the power over the protozoal diseases the diminishing force of tuberculosis and syphilis even acute rheumatism with the damage it inflicts on young life is less powerful for evil—these and other achievements bear witness to a changing scene.

The sub-infections which play a relatively larger part in the health problems of today bring home to us the importance of the individual or host and the make up of his body and mind. Their activities in each individual would seem to be determined by some internal factor—some nidus or influence which is probably specific for that person. Thus an attack of rheumatoid arthritis from infected teeth is determined as much by the internal factors individual to that patient as by the infective agent and not the least suggestive feature of the recent advance in our knowledge of malignant disease from the brilliant researches of Gye and Barnard is the importance of this internal factor in the production of the disease. In short specificity of the

soil looms as large as specificity of the infective agent

From another point of view this concern of medicine for the individual man—his resistance—his qualities which make for good and for evil—pushes disease back to its beginnings. We thus become concerned with the fascinating though difficult study of trends and tendencies—with the border country between the physiological and the pathological and this leads one to reflect that the limits of the physiological widen with the advance of civilization. And the body like the mind, has its inborn traits. Physiological habit corresponds to character. Who is to say where peculiarity ends and fault begins? Advancing age tends to harden peculiarity into fault. Moreover what we view as peculiarity in ourselves we are apt to term fault in other people. Thus determination becomes obstinacy and strong will becomes self will and conviction becomes obsession and the latter suggests that the philosopher will make his convictions merry so that his old age may possess content.

Take essential hypertension—no doubt this is sometimes an acquired condition but equally often it is an inborn physiological habit an over responsiveness of the vasoconstrictor mechanism which begins as a peculiarity and may end as a fault or disease—commences in the realm of the physiological and ends in that of the pathological. The irritable heart the over responsive abdomen are other examples. Our object should be to take cognizance of habits and trend and so guide their human possessor that his potentialities operate for his good not for his harm.

Here then there is contact between medicine and education—their spheres overlap—their needful aptitudes resemble. The qualities of mind needed in a diagnostician are as essential to the teacher as to the doctor.

And from this I am led to reflect that teaching will become a prescribed duty in the doctor's career.

How can it be otherwise?

If we are to get to the beginnings if we are to guide people in the ways of health, if the community is to guard the health of its mothers its babies its school children its industrial workers the family doctor must become an educationalist and in part a health administrator. If he does not his rôle will suffer progressive diminution curtailed as it will be on the one hand by the whole time health official and on the other hand by the invading specialist.

Thus will in my judgment be a disadvantage to the community. The family has need of its

own doctor known and trusted and it is with his guidance its members should get all that is best from specialism, and thus is the more necessary in a day when specialization begins early in the doctor's career and is apt to become restricted in vision.

The family doctor should remain the foundation of medical service but his outlook functions and training need modification to meet changing needs. First must come his care of the sick but beyond that he will have communal and educational duties.

Take for example the value of medicine toward industry, the physical fitness of the worker the survey of his environment the gauging of the suitability of body and temperament to the work required the strains connected with specialization and that new large field of research into the problems of industrial fatigue.

In all these things which concern not only the health and happiness but the efficiency of the worker medicine has responsibility.

Few doctors in a community could fulfill the whole range of such demands. I suggest that in the future the doctors of a district will form themselves into a faculty which would place the varieties of knowledge and experience of its members at the service of the community and in its collective capacity exercise a powerful and much needed influence on public life.

Withal let us do nothing which would impair the personal touch the deep and abiding interest which mean so much in the hour of need for our rosary needs to be strung with the beads of love as well as with those of thought.

How then are the members of this local faculty to hold high their standard of work? The answer is by the hospital. Every district however rural should have a hospital adapted to its need. For myself I should like to see the conception of such a hospital widened to that of a health center where curative work clinic wards communal services educational facilities—could find a home—where doctors could improve their minds give of their best and find encouragement and restraint. And in this connection is to be found one of the most beneficent activities of this illustrious College.

This larger view of the district hospital carries with it a wider conception of the art of healing. Dietetics physiotherapy belong as much to education as to healing. With greater knowledge we have come back to simplicity.

The surgeons first found salvation in fire by the discovery of asepsis and the rest find in air and light a romance of healing. Who would have

thought a few years ago that the simplest of hospitals built on the Cattle Byre type with open air, sun good food aided by a knowledge of anatomy and physics, as their only armamentarium would have produced the transformations to be found in modern orthopedic hospitals.

And the beneficial results extend far beyond the patients cured for each one of the latter becomes a missionary of health a nuisance to his family, in that he enforces upon its members light and air to their surprise discomfort and salvation.

For one cured many are saved which dictum is further emphasized in the hygiene of the mouth for the treatment of oral sepsis has done even more by its terrors than its cures.

Next may I let chemistry lead me to another line of thought. In the discovery of hormones by Starling chemical products were found to have a direct control of function. Consideration of the rôle of these chemical messengers of which carbon dioxide may be said to be the exemplar gives us a wider comprehension of the wisdom of the body and the physical scope of say secretin and insulin is within our ken and gives clearness to our conceptions and range to our activities.

But that minute quantities of a chemical product the output of a group of cells should so far be the arbiter of the physical and mental states of the body that its presence will decide whether the body is to have or not have vigor and beauty and the mind power to think and remember leaves one almost dazed with wonderment. And yet so it is as the isolation of the active principle from the thyroid gland exemplifies.

Again it would seem that secondary and to less extent primary characteristics are the result of chemical substance originating in specialized groups of cells and such bodies not only determine sex at the outset but will change sex characteristics during life's progress and with the bodily changes will be the corresponding modifications of mind and character and if one goes one step farther and contemplates the beautiful attributes of the mother instinct which have inspired the art and religion of the world as resulting from stimulation by a chemical product are not the limits of our comprehension passed and our minds unsatisfied? Is the hormone the influence itself or the embodiment of the influence? Or is it the physical counterpart of the spiritual quality of influence?

There are in both the same qualities of subtle and reiterated effect in both of them we get a detachment from the material conception of mere bulk and weight and our minds glide back to the

little leaven and 'the grain of mustard seed. The rôle of the infinitely small carries thought to the border country of the material.

From this it is but an easy step to my next theme that is the place of psychology in medicine, which term I take to signify the study of the mind in health and illness.

This must claim more of our attention partly because the knowledge of mind has made striking advance and partly because the need for its help increases. And psychology needs to be taken into the texture of medical practice and not regarded as an extraneous aid. Its delicate processes requiring as they do insight and sympathy find encouragement and balance if they are as the warp to the woof of physical symptoms.

Standing apart psychological practice may easily fail in acceptance and purpose and even produce antagonism. This is due in part to the outlook of patients and in part to the crudity of many of its proponents.

Broadly speaking patients regard disturbances of mind as things they can avoid and disturbances of body as things they cannot avoid.

Although neurosis is equally if not more prone to attack the higher type of mind its diagnosis is apt in spite of every explanation to debase the patient and prejudice cure. So it happens that the physical and psychical should wherever possible be handled together. Priority of presentation should be given the physical and it should be remembered that the disturbed mind is often helped best by treatment which is incidental and even unwitting. This is only another way of saying that the finer thoughts and feelings may be killed by attempts to give them a too concrete form. And yet by a strange irony there is a school of psychological medicine earnest in advocacy which has presented us a picture of the human mind and its processes so crude and unattractive as to prejudice the acceptance of the great and valuable learning on which it is based.

For in truth medicine owes a great debt to those teachers Freud and others whose inspiration has disclosed to us the workings of the unconscious mind and their relations to those of the conscious. The principles of these teachers are not less true because the latter overestimated the rôle of the sexual instinct and their disciples have mistaken the wood for the trees.

And the conditions of modern life its speed its complexities the fact that mechanical invention has outstripped man's power of adaptation must not only produce exhaustions but set up strains conflicts and make the mind enter more into the make up of illness than in the placid

days of yore. And so it happens that not only do neuroses become more common but physical illness is apt to be overlaid and interthreaded with troubled states of mind. Clinical values have changed. And the vagaries in the manifestation of disease which so often vex its unraveling are sometimes the result of mind reactions—of personality.

How often do we not find that an illness with a physical basis which is perhaps amenable best to surgical interference may have a superstructure of functional disturbances due to present or buried mental experiences not only perplexing the patient and doctor but prejudicing recovery. Thus is explained why some operations cure the condition but not the patient.

It is an interesting reflection that while on the one hand the technique of diagnosis is growing in range and reliability, on the other hand the problem before it grows in complexity.

This tells us that laboratory technique, though essential is not all sufficing, it throws light on the morbid process but not on the reaction of the latter. It leaves individuality untouched unless as is possible variations in biochemical reactions may in the future disclose a correspondence with variations in bodily and mental functions.

I will next refer to the handling of the mind factor in disease. For reasons given the technique of psychoanalysis, suggestion and hypnosis though in specially skilled hands, and in exceptional cases useful are in general medicine seldom necessary or desirable. The mind cannot like the body always stand set and formal treatment for the texture and interlacing of the threads of its web are too delicate. Exploratory operations on the mind do not always heal by first intention.

The best treatment often lies in comprehensive diagnosis and by that I mean the unraveling and exposition, not only of the nature of the morbid process but the physical and mental states associated with it.

Sort out a patient's symptoms for him. It is not things but the significance of things which matters. Discomforts ignored in health are liable in neurosis to become obtrusive and produce fears. Such may impede the cure of bodily illness or a function may be raised in consciousness or again a conscious experience may be misinterpreted and assume a sinister significance or again exhaustion may lessen control so that an instinctive tendency naturally suppressed rises up and produces conflict.

Such factors must, in my judgment contribute increasingly to the make up of illness and demand our recognition. Explain causes dissolve doubt and side by side with the best physical treatment restore perspective and the path to recovery and contentment opens out.

An important part of therapeutics is a willingness to listen, a perceptive understanding mind and lucid persuasive exposition.

To those who have tonight been received into your Fellowship may I offer my felicitations and good will. A great heritage and an inspiring outlook are theirs—quest of knowledge, the beauty of craft, the privilege of help and healing, the leadership of their communities toward increasing health and contentment. Between nations medicine stands for reason, forbearance and mercy and with the English speaking peoples it is a beacon light showing the way to closer understanding and the unity of an ever-deepening friendship.

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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## SUPPURATIVE DISEASES OF THE LUNG DUE TO INSPIRATED FOREIGN BODY CONTRASTED WITH THOSE OF OTHER ETIOLOGY<sup>1</sup>

By CHEVALIER JACKSON M.D. & D. F.A.C.S. PHILADELPHIA PENNSYLVANIA

THE literature of suppurative diseases of the lung is so huge that one should hesitate to say what it does not contain but nowhere have I encountered the drawing of a sharp line of distinction pathological or clinical between suppurations due to endobronchial foreign body and those of other etiology. Of the existence of such a line we have at the Bronchoscopic Clinic an abundance of clinical evidence, some of which has been presented (1 2 3 4 5 6 7 8 9 18). The purpose of this paper is to call attention not to bronchoscopy but to the generally unrecognized difference between suppuration due to foreign body and that due to other causes. In the author's opinion such a high percentage of cures cannot be obtained, bronchoscopically or otherwise in lung suppuration of other than foreign body origin.

One of the most curious and interesting phases of this subject is the remarkable and complete cure effected by the bronchoscopic removal of a relatively small foreign body from the bronchial focus of a relatively large area of suppuration. Anyone who has contended for months or years with lung suppuration of other etiology, say a post influenza abscess for instance is amazed to see a foul suppurative process of many years duration involving an entire lobe clear up without further treatment in a few months after the removal of a foreign body from the bronchus

tributary to that lobe. Even more remarkable is the fact that after a few years such a lobe will resume its function and neither by physical signs nor the roentgen ray is it possible to detect unusual fibrotic or other permanent pathological change. We have not simply an odd case or two but over a hundred of these long duration suppurative cases illustrative of this clinical fact. The usual chronicity of lung suppuration cases in general has led many an unsuspecting practitioner to treat a patient with copious foul expectoration for years until there came a day when a roentgenologist revealed a foreign body. Following the bronchoscopic removal of the foreign body the practitioner has been astonished soon to see the foulness of years standing disappear, later the expectoration cease and still later the patient make a complete recovery. Such recovery is the rule after bronchoscopic foreign body removal; it is the exception after suppuration of equal duration that has arisen from other causes.

### SUPPURATION OF OTHER THAN FOREIGN BODY ORIGIN

The characteristics of pulmonary suppuration are so well known as to need no enumeration here. For purposes of contrast however mention may be made of a few of the many types. Diffuse spreading suppurative pneumonia and sloughing gangrenous processes



days of yore. And so it happens that not only do neuroses become more common but physical illness is apt to be overlaid and interthreaded with troubled states of mind. Clinical values have changed. And the vagaries in the manifestation of disease which so often vex its unraveling are sometimes the result of mind reactions—of personality.

How often do we not find that an illness with a physical basis which is perhaps amenable best to surgical interference may have a superstructure of functional disturbances due to present or buried mental experiences not only perplexing the patient and doctor but prejudicing recovery. This is explained why some operations cure the condition but not the patient.

It is an interesting reflection that while on the one hand the technique of diagnosis is growing in range and reliability on the other hand the problem before it grows in complexity.

This tells us that laboratory technique though essential is not all sufficing; it throws light on the morbid process but not on the reaction of the latter. It leaves individuality untouched unless as possible variations in biochemical reactions may in the future disclose a correspondence with variations in bodily and mental function.

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FIG. 3 (Case No. Fbdy 1127) Roentgenogram showing the condition in the right lung due to the presence for 3 months of a tooth. Bronchoscopic removal of the tooth was followed by complete recovery.

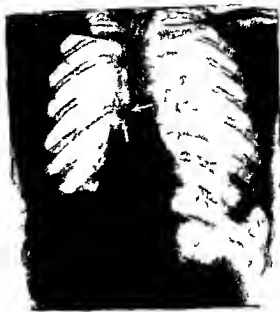


FIG. 4 (Case No. Fbdy 1148) Roentgenogram showing atelectasis of the right lung due to the obstruction of the right bronchus by a tack inspired 9 years previously. The abscess had been drained externally once 7 years before admission, the opening being allowed to close. Suppuration continued as long as the tack was present but ceased a few months after bronchoscopic removal of tack.

series of foreign body cases as to establish the fact beyond question (1 2 3 5 6 7 9 18)

#### CLASSIFICATION OF FOREIGN BODY SUPPURATION

This subject has been extensively studied at the Bronchoscopic Clinic with results of the utmost clinical importance. As many of these studies have been published (1 2 3 4 5 6 8) it will be necessary here only to repeat a few facts essential to the presentation of the present subject.

For the proper consideration of pulmonary suppuration caused by the entrance of a foreign body into the lung by way of the trachea and bronchus it is essential to recognize the clinical fact that there are two groups of foreign bodies presenting a marked contrast in their tendency to produce suppuration, namely (1) vegetable substances and (2) other substances.

Another essential is to recognize the clinical fact that suppuration is closely associated with the mechanical condition of the degree and kind of obstruction. These we have (14) classified as

1. By-pass valvular obstruction permitting a diminished quantity of air to pass in and out. This results in diminished ventilation and impeded drainage.

2. Check valve obstruction in which the air can get in but its escape is hindered. This produces obstructive emphysema in the invaded lung.

3. Stop valve obstruction in which the bronchus is completely closed.

The fundamental importance of the foregoing classifications of kinds of foreign body and kinds of bronchial obstruction is shown by their bearing on the clinical facts that a peanut kernel in the bronchus sets up a suppuration that may be fatal to a baby in weeks (8) whereas a screw may produce suppuration in the lung for 40 years (from childhood to middle age) not only without being fatal but without totally disabling the patient.

With the foregoing clinical facts in mind we may proceed to contrast pulmonary suppuration due to inspired foreign body with that of other etiology.



Fig 1 (Case No Fbdy 412) Roentgenogram<sup>1</sup> show ing suppurative pneumonia involving the entire right lower lobe caused by occlusion of the stem bronchus by a tack. Duration 3 months. At a rib resection done before admission for a supposed empyema the pleura was found normal primary unit. Then roentgen ray examination had revealed the tack. Recovery after bronchoscopic removal



Fig 2 (Case No Fbdy 1106) Roentgenogram showing abscess of the left lower lobe in a boy aged 17 years due to a dental brace in pirated 1 year and 4 months before the child was brought to the clinic for examination during an abdominal operation. Complete recovery followed the peroral bronchoscopic removal of the dental brace.

are not uncommon as the result of direct trauma pneumonia infarct and of operations upon the tonsils upper air passages and more remote regions. It cannot be too strongly emphasized that such processes are so exceedingly rare that we may say they do not occur after the inspiration of a foreign body into the bronchi. Bronchiectasis of other than foreign body etiology is when well established a disease that is exceedingly difficult of cure by medical or surgical means and even when these are supplemented by bronchoscopic aspirations curative results are slowly and often only incompletely obtained.

#### PULMONARY ABSCESS AND DROWNED LUNG DUE TO FOREIGN BODY

We have frequently pointed out (1, 2, 3) the anatomical difference between a purulent collection in a section of the bronchial tree due to occlusion of the tributary bronchus on the one hand and an abscess with breaking

down of the bronchial wall and other lung structures on the other hand. Bronchoscopic removal of the foreign body before the abscess formation results in a cure within a few weeks. At a later period a longer time is required for recovery but recovery is almost invariably the ultimate result. It must be remembered however that complete breaking down of the tissues such as is common in post tonsillectomic post pneumonic post influenzal and tuberculous abscesses with cavitation air content and fluid level has rarely if ever been present in any case of foreign body of short or prolonged sojourn coming to the Bronchoscopic Clinic. The pathological processes seem to be rather those of hyperplasia than of liquefaction of tissue. Whether or not this fully accounts for the difference in the clinical course we are not prepared to say but the clinical fact remains that the 98 per cent of recoveries from suppurative diseases of the lung after bronchoscopic removal of a foreign body is unparalleled by any other form of lung suppuration. This statement is based not upon a case or two but upon such a long

<sup>1</sup>Th. oe. tg. aer. m. used. th. t. l. w. h. tw. x. p. d. w. w.  
m. d. by W. H. F. M. g. Those h. w. F. g. d. f. g. g.  
8 we e. m. d. by F. d. k. W. O. B.



Fig 7 (Case No Fbdy 1156) In this case the lung suppuration from the presence for 2 years of the hook shaped piece of wire entirely disappeared after the bronchoscopic removal of the foreign body



Fig 8 (Case No Fbdy 1250) Suppuration in left lung resulting from bronchial obstruction during the 6 years presence of the staple. Recovery without treatment other than the bronchoscopic removal of the foreign body

granulations after a symptomatic interval of over 2 years duration evidently resulted in suppuration that in the course of many years increased in severity until an abscess with almost fatal hemorrhages brought the patient to a state of serious ill health after 28 years sojourn of the pin. Bronchoscopic removal was followed by entire and complete recovery. There is today no residual sputum, no roentgen ray or physical signs by which to identify the previously suppurating area.

Case No Fbdy 1559. Portion of safety pin in the lung for 15 years. A woman aged 29 years having had cough with slight mucopurulent expectoration for 15 years came under the observation of Dr. S. B. Thomas who advised a roentgen ray examination of the chest. This revealed a metallic foreign body looking like a bent wire for the removal of which the patient was referred to the Bronchoscopic Clinic. The patient when questioned vaguely recalled having swallowed a safety pin while trying to close it with her teeth when a child of about 14 years of age.

Professor McCrae reported as follows: Patient's general condition is good. No dyspnea. No wheeze. Expansion is diminished on the lower right side. There is dullness which corresponds particularly to the lower right lobe possibly the note was slightly less resonant than normal over the middle lobe. On auscultation breath sounds were distant. I was unable to get any marked alteration on deep breathing and I heard no rales. Vocal fremitus was diminished over the lower right lobe otherwise the examination seemed negative. Signs suggest lower lobe involvement.

Dr. W. F. Manges reported as follows: There is a metallic foreign body very much the shape of a beauty pin except that it has neither a hinge nor an actual spring at the closed end. At the keeper end

there is a hinge with a slight projection on the side toward the point. This projection may possibly be a keeper for the point or the foreign body may be the point portion of a large safety pin with a part of the spring in a U shape bent into the shaft. The point end is toward the median line and directly behind the right border of the heart. It lies in the direction of the right stem bronchus. I suspect that the point has probably embedded itself in the inner wall of the bronchus. There is considerable evidence of a pathological condition in the region of the foreign body as well as distal to it. (Fig 19)

**Bronchoscopy.** The right main bronchus was found occluded by an epithelialized granuloma just below the orifice of the middle lobe bronchus. The granuloma was removed with forceps. The ring end of the pin was grasped with rotation forceps and the Manges roller bronchoscope was pushed down over the pin as far as the ring. The bronchoscope being held rigidly the ring was pulled into the tube mouth thus the curve of the pin was straightened out on the roller.

There was no reaction and the patient was discharged a few days later. Her present condition is excellent.

The relatively slight suppuration, the lack of general and local reaction to the presence for 15 years of the foreign body in the lung is in part due to the shape of the foreign body which did not cause obstruction to ventilation and drainage until the development after some years probably of sufficient secondary pathological obstructive tissue. The other factor in the limited degree of illness which was



Fig. 5 (Case No. Fbdy 1153) The shadow of a dental filling is seen behind the heart shadow. An abscess resulting from the 3 months obstruction of the left bronchus by the dental filling healed promptly after the bronchoscopic removal of the foreign body.

#### SUPPURATION DUE TO METALLIC FOREIGN BODIES

The characteristics of this class of cases especially when non obstructive are (a) the long symptomless interval after the lodgment of the foreign body and (b) the mildness of the symptoms when they develop. There is no pain and there is usually little or no cough or fever. Shock, prostration or toxæmia are practically never present. The patient is usually unaware of anything abnormal and only too often the medical attendant is misled into giving a negative opinion as to foreign body. This apparently normal condition of the patient immediately after the inspiration of a foreign body may be contrasted with the grave symptoms at the onset of pulmonary suppuration due to septic infarct pneumonia, post tonsillectomic or supposed post anæsthetic abscess.

In a recent presentation (9) of cases of overlooked foreign bodies in the lungs I referred to cases in which foreign bodies had been in the lung for periods up to 36 years. A number of such cases have been previously



Fig. 6 (Case No. Fbdy 1237) The suppurative area distal to the tack of which the shadow shows in this roentgenogram disappeared completely without treatment other than the bronchoscopic removal of the tack. The tack had been in the lung for a year and a half.

published (3, 4) and many appear in the complete tabulations (1, 2, 3, 7, 18) of our Clinic. From among these cases we may call attention to the following cases by their serial numbers by which they can be identified in the tables referred to.

Case No. Fbdy 1095. Screw in the lung of a baby from the time it was 15 months old until it was 3 years old, 21 months. The suppuration was continuous after 17 months but the child was not extremely ill. Complete recovery followed bronchoscopic removal.

Case No. Fbdy 986. A shawl pin in the lung of a girl aged 10 years for one and a half months with out a single symptom and without suppuration. After bronchoscopic removal the child could scarcely be said to recover since there was nothing from which to recover. She was normal before bronchoscopy and normal afterward. The foreign body was metallic and it was non obstructive up to the time of removal. We have had over 150 such cases. Later the foreign body would have become obstructive and suppuration would have followed with all its systemic sequelæ.

Case No. Fbdy 726. A shawl pin in the lung of a woman aged 41 years for 8 years. Here we had the same kind of a pin as in the foregoing case. It was metallic and was non obstructive for many years during which time there were no suppuration and no symptoms. Eventually however a corrosion of the pin resulted in increasing its bulk and in the production of granulation tissue by the mechanically irritating roughness. The increased bulk and the



FIG. 11 (Case No. Fbly 124) At sciss of lower lobe of right lung due to 3 years abscess of a tooth. Complete recovery ultimately followed the bronchoscopic removal of the tooth without other treatment.



FIG. 12 (Case No. Fbly 1279) The suppuration in the right lower lobe was due to the bullet which had been present for a month in a child aged 4 years. The lung cleared completely with no treatment other than the bronchoscopic removal of the bullet.

**Bronchoscopy.** The tracheal and main bronchial mucosa were not obviously diseased. On going down the right stem bronchus we found the mucosa of the lower lobe bronchus rather pale and cicatricial in appearance, small vessels being visible at a number of locations. Just below the orifice of the middle lobe bronchus the lumen of an internal branch of the lower lobe stem was found to narrow down in a laterally flattened funnel shape to a small (about 3 millimeter) lumen which was occupied by a small mass of reddish granulations. The patient not being anesthetized was requested to cough which resulted in squeezing up a small amount of slightly odorous pus. This was wiped away. Dilating forceps were inserted, allowed to expand and then withdrawn in the expanded position. The closed forceps were cautiously inserted a millimeter at a time, their direction being checked and corrected at frequent intervals by Dr. Manges. When the head of the screw was reached the forceps were allowed to expand sufficiently to grasp it. The structure having been previously dilated with the expanding forceps no resistance was felt on withdrawal of the screw from its substructural bed. Duration of bronchoscopy was 7 minutes 21 seconds. There was no general reaction; the temperature rose to 99.2 degrees F. that evening but subsided during the night to normal. The patient was discharged 2 days later. Now 3 months later she is well on the way to complete restoration of health.

The inspiration of the screw was about 10 years before Roentgen discovered the rays which bear his name. It took about 10 more years for the ray to come into general diag-

nostic use. For 20 years then we may say that the correct diagnosis could have been made at any time had foreign body been thought of as a diagnostic possibility. More over the ease and certainty with which any well qualified practitioner can by physical signs detect an extensive area of bronchial obstruction such as must have been present with a screw of this size in a child less than 7 years old should have lead to a correct diagnosis. Doubtless there were no symptoms for a long time but the physical signs would certainly have been there had they been elicited. The history of foreign body could have been elicited by questioning. This failure to consider foreign body as a diagnostic possibility to be excluded in every case of pulmonary disease with or without a history of foreign body is the result of a shortcoming in the teaching of the medical student. The relatively small amount of pulmonary pathology present in this patient corroborates an observation we have made (1, 2, 3) that metallic foreign bodies seem to have a germicidal action that holds suppurative processes in check until complete obstruction occurs and even then exerts a certain degree of the same power.



Fig 9. (Case No. Fbly 1391.) The staple shown was inserted when the patient was 8 years of age and remained in the lung for 15 years. The resultant pulmonary abscess completely healed with no treatment other than the bronchoscopic removal of the staple. The foreign body shown is retouched for clarity in this and some of the other illustrations.

associated with 15 years of lung suppuration was due in our opinion to the germicidal action of a corroding metallic foreign body.

Case No. Fbly 1530. Foreign body (a screw) in the lung for over 40 years. A woman aged 47 years visited Dr. Frederick W. O'Brien complaining of ill health since childhood. She had always been delicate and subject to attacks of fever with cough and some expectoration. Recently there had been local distress over the right lung but the temperature was elevated only slightly and occasionally. Most of her previous medical attendants had made the diagnosis of chronic bronchitis. Dr. O'Brien made a roentgen ray examination which revealed a metallic foreign body of the shape of a wood screw deep in the right lung. After the screw was discovered by the ray the patient recalled having been told by her mother that when she was less than 7 years old her mother had found her screaming and crying locked in a room. When her mother had got into the room the child had said that she had swallowed a screw from a cup. The family physician when consulted said it would pass.

The patient was referred to the Bronchoscopic Clinic for the bronchoscopic removal of the screw.



Fig 10. (Case No. Fbly 1261.) The suppuration involving almost the entire left lung was due to the presence of an aspirated safety pin for 4 years. A complete return of the lung to normal followed the bronchoscopic removal of the safety pin.

Dr. Elmer H. Funk reported as follows: Patient is fairly well nourished, no clubbing of the fingers, heart normal. There is slight wheezing but no dyspnea nor cyanosis. Expansion is limited over the entire right side. Percussion note is clear anteriorly, high pitched (wooden tympany) posteriorly on the right side. Breath sounds over this region bronchovesicular. A few fine crackles are heard near the apex, medium and fine rales from apex to base with greatest intensity near the angle of the scapula. No evidence of cavity formation.

**Röntgen ray examination.** Dr. Willis F. Mangus reported as follows: There is a screw about 13 millimeters in length, apparently in the anterior branch of the right lower lobe bronchus in close relation to the mouth of the lower lobe bronchus. There is considerable fibrosis just at the screw and anterior and distal to it. In the lateral view it lies about 1 inch in front of the anterior border of the vertebral bodies and in the anteroposterior view it lies at the level of the ninth rib just about 1 inch to the right of the right border of the vertebral bodies (Fig. 18). Point is downward and I suspect that because of this drainage has been maintained very much better than if the head had been downward. There evidently has been some corrosion but it is possible to recognize the shadow of the head of a screw. The lung tissue outside of the area of the foreign body is remarkably clear in view of the long sojourn of the foreign body.

**Blood examination.** by Dr. I. C. Lintgen was reported as follows: red blood cells 4,300,000; hemoglobin 60 per cent; white blood cells 7,600; color index 81; polymorphonuclears 60; small mononuclears 34; large mononuclear 0; transitional 4; eosinophiles 2.



Fig 15 (Case No Fbdy 1307) The abscess in the right lower lobe followed 3 months sojourn of the dental filling the shadow of which is here seen. Recovery to the previous average degree of health followed bronchoscopic removal of the foreign body. The patient had a bronchial history long antedating the foreign body accident.

abscess and of pulmonary tuberculosis had been made and abandoned in favor of a diagnosis of bronchiectasis. A roentgen ray examination confirmed the diagnosis of bronchiectasis but revealed the presence of a metallic object about a centimeter in length by about half as much in width deeply down near the bottom of the right lung overlapping the liver shadow. He was referred to the Bronchoscopic Clinic for removal of the foreign body. The presence of bronchiectasis was confirmed by (a) the physical examinations of Professor McCrae and Dr Elmer H. Funk, (b) the roentgen ray examinations of Drs David R. Bowen and Arthur V. Sender and (c) by direct inspection with the bronchoscope at the time of removal of the foreign body. After the removal the expectoration of pus rapidly lessened and within a year had disappeared. At the end of 5 years during which time there was no treatment other than outdoor living conditions the patient's father, a physician, wrote to us as follows: "Weight 78 pounds, height 4 feet 11½ inches. Chest expansion 4 inches. Examination of the chest reveals no abnormality. Generally speaking he is free from colds and he is not troubled with cough. He will be in high school next year."

While it is impossible to say without a bronchoscopic examination that the formerly dilated bronchi are now free from sacculations and are normally proportionate in diameter to the present age of the patient, nevertheless the total disappearance of cough and of expectoration are sufficient to warrant an inference of perfect cure and to afford a basis for contrast with the usual course of bronchiectasis due to causes other than foreign body.



Fig 16 (Case No Fbdy 1447) The nail shadowed here had been in the lung of the 10-year-old boy for half his lifetime. Attempted removal by external operation had been unsuccessful. Complete recovery followed the bronchoscopic removal of the nail.

#### SUMMARY OF CASES OF PROLONGED SUPPURATION FROM METALLIC FOREIGN BODIES FOLLOWED BY COMPLETE RECOVERY

In order to convey some idea of the cases on which we base the opinions above expressed we may enumerate a few examples. These are cases of prolonged sojourn only. Cases of

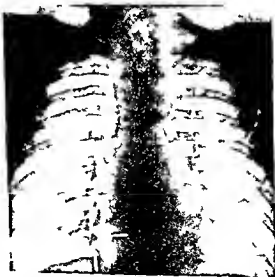


Fig 17 (Case No Fbdy 1415) The dental filling had been in the lung for over a year. Complete recovery followed bronchoscopic removal of the foreign body.





Fig 13 (Case No Fbdy 1383) Needling and rib resection had both been negative for empyema before the roentgenogram was taken. The suppuration due to the prolonged sojourn of the screw healed completely after bronchoscopic removal of the foreign body.

This is in marked contrast to suppuration of other than foreign body origin such as that following lobar pneumonia, with its large area of devitalized often sloughing tissue. In making this comparison and in contrasting this case with cases of long sojourn of penetrating projectiles it must be remembered that this foreign body was not encysted. It was in the bronchus at first surrounded by normal wall later surrounded by a gradually increasing fibrotic barrier built up by granulation tissue. This granulating area was probably at all times in direct communication with the bronchial stem through which the never copious purulent discharge drained and through which air with its potentially infective agents had access. It is evident that there was a highly efficient defense against the spread of septic processes and probably also a germicidal effect tonic or other exerted by the foreign body itself.

#### BRONCHIECTASIS DUE TO METALLIC FOREIGN BODY

Bronchiectasis indistinguishable by symptoms general examination or physical signs from that due to other causes has been found in many of our cases of prolonged sojourn of a foreign body in the lung. The clinical course of these cases after removal of the foreign



Fig 14 (Case No Fbdy 1394) The area of suppuration in the right lower lobe was due to the presence for a month of the tooth filling whose shadow shows. Complete recovery followed the bronchoscopic removal of the foreign body.

body is in such striking contrast to anything seen in well established bronchiectasis due to other causes as to point to an essential pathological difference but exactly what constitutes the structural differences we have not been able to determine because of the rarity of mortality and consequent dearth of autopsies. The almost incurable nature of well established bronchiectasis due to the usual causes is well known. On the other hand foreign body bronchiectasis even when very extensive and present for years usually gets well spontaneously after bronchoscopic removal of the foreign body. Many remarkable examples of this are among our case records many of which have been published (see appended list of references). The citation of one case will suffice here.

Case No Fbdy 659 Well established bronchiectasis cured by bronchoscopic removal of the causative foreign body. A boy aged 8 years the son of a physician had had cough foul expectoration clubbing of the fingers and general ill health since an attack of hemoptysis and supposed pneumonia at about 2 years of age. Diagnoses of post pneumonic

11 cases Long durations were 1 and 4 years One patient very ill on admission died of septic pneumonia before any bronchoscopy was done This one case and the fact that no sojourn of longer than 4 years is recorded among our cases suggest an unusually aggressive type of suppuration in cases of teeth in the bronchi This is borne out by the clinical findings in nearly all cases Thus rather aggressive type of suppurative process makes the fact that bronchoscopic removal was always followed by recovery of the patient all the more remarkable when contrasted with suppurative cases of other than foreign body origin

In cases of a tooth in a bronchus the symptomless interval is short and may be absent the cough appears early usually within 24 hours and is generally frequent and annoying often paroxysmal

Illustrative of the recovery after the more aggressive suppuration associated with dental foreign bodies the following case may be cited

Case No Fbdy 840 Tooth in the lung for 6 months A woman aged 31 years was ill in bed for 6 months after extraction of a number of teeth The symptoms were severe paroxysmal cough copious expectoration and irregular fever ranging up to 102 degrees F emaciation from 120 to 86 pounds Diagnoses were pleurisy and tuberculosis The sputum was always negative X ray examinations showed the root of a tooth In 4 months after bronchoscopic removal the patient had gained 35 pounds in weight cough and expectoration had ceased and the patient was perfectly well

Many cases similar to the foregoing will be found in our published records (1 2 3 4 5 6)

#### **PATHOLOGICAL BASIS FOR THE DIFFERENCE BETWEEN SUPPURATION DUE TO FOREIGN BODY AND THAT DUE TO OTHER CAUSES**

That there is a difference in the tendency to recovery after the removal of the intruder however septic it may have been on inspiration is compared to suppuration due to infective agents that have reached the lungs independent of a foreign body is conclusively proven by a great mass of clinical data When we attempt to determine why this is so we get into the realm of inference with all its potential elements of error A few facts however are apparently well established

*The foreign body itself is the chief obstruction to drainage* When approached with a bronchoscope in a case of recently aspirated obstructive foreign body the foreign body itself is obviously occupying the lumen of the bronchus and constitutes the chief obstructive agent In such cases we find suppuration early If the foreign body by reason of its size form or position is *not obstructive* we do not find suppuration in recent cases especially if the foreign body is metallic If however the foreign body has been present for a long time we find the metallic foreign body corroded and buried in granulation tissue the foreign body and the diseased tissue together constituting the obstruction As soon as we disturb this obstacle to drainage pus wells up from below and it is foul showing stagnation

When we go down into the bronchus of a lung that is suppurating from a cause other than foreign body we often find a similar obstructing mass of granulation and granularomatous tissue But it is an abundantly proven clinical fact that removal of the granulations in the latter class of cases while ultimately helpful if repeated as often as they reform will not produce the remarkable recovery that almost always follows removal of the foreign body only from its bed of granulation tissue in the foreign body class of case

One inference is that the bulk of the foreign body is itself the chief obstructive factor and this is doubtless true of many cases Another justifiable inference is that the presence of the foreign body by its irritation perpetuates the formation of obstructive granulation tissue which disappears after the mechanical irritant is removed That it does disappear in foreign body cases and does not disappear in other cases we know by inspection In many of the non foreign body cases it often continues to reappear even after many removals

*Is there a barrier to infective invasion of the lung by way of the bronchi?* Another inference is that there is a barrier structural or physiological to infective invasion by way of the bronchial mucosa All our records seem to indicate that there is such a barrier It also seems that the barrier has been more efficient in some cases than in others



Fig 18 (Case No Fbily 1520) Roentgenogram showing a suppurative area in the right lower lobe due to the presence of a screw for a period of 40 years in a woman aged 47 years. The small amount of pathologic present point to the existence of a barrier against suppurative infection by the endobronchial route and also to a germicidal action of metallic foreign bodies in the bronchi.



Fig 19 (Case No Fbily 1538) A roentgenogram of a woman aged 29 years showing the pathology in the right lung due to the presence of a portion of safety pin for a period of 15 years. The limited amount of pathologic points strongly to the existence of a barrier structural or physiological against infective invasion of the lung by the endobronchial route, and also to the existence of an antiseptic action resulting from ionization or otherwise associated with the presence of metallic foreign bodies in the bronchi.

short sojourn are not germane to our present purpose. Details of the cases will be found in the tabulated and other published reports of the Bronchoscopic Clinic.

**Tacks.** We have had over 45 cases of tacks. The long duration cases were as follows. In 14 cases the tacks were present from 1 to 7 months. In 7 other cases the tacks were present for the following number of years:  $1\frac{1}{2}$ , 2, 2,  $2\frac{1}{2}$ , 5, 9, 20. With one exception all patients recovered after bronchoscopic removal of the tack.

**Staples.** Of 15 cases of staples the foreign body was present from 1 to 5 months in 4 cases, in 3 other cases for 6 and 15 years respectively. In all cases of prolonged sojourn the patient recovered after bronchoscopic removal of the staple.

**Screws.** Omitting the recent cases, out of 8 cases of screws 4 were in the lung for period of from 1 to 3 months. In 3 other cases the duration of sojourn was  $1\frac{1}{2}$ , 2 and 40 years respectively. All patients recovered after bronchoscopic removal of the foreign body.

**Pins.** Of 60 cases of pins 50 cases were of short sojourn. In 6 cases the pins were present from 1 to 5 months. In 4 cases the sojourn was 5, 7, 18 and 8 years respectively. In all the long sojourn cases the patient recovered. The patient in whose lung the pin was lodged for 18 years was the daughter of a physician. She has married and is in perfect health.

**Safety pins.** Omitting recent cases, notable long durations were from 1 to 10 months in 8 cases. Longer sojourns were 2, 4, 15 and 36 years. All patients recovered.

**Collar buttons.** Omitting recent cases, prolonged sojourns were 2 and 8 months and 1, 4, 10 and 26 years. All patients recovered.

**Pencil caps and other brass caps.** Notable prolonged sojourns were  $1\frac{1}{2}$ , 2 and 21 years. All patients recovered.

#### LUNG SUPPURATION DUE TO DENTAL OBJECTS

**Teeth and fillings.** Omitting 15 recent cases there were sojourns of from 1 to 7 months in

- 6 Idem Dilatation of bronchial structures J Am M Ass 1912 lxi 1123 (The two patients whose cases are therein reported are alive and perfectly well today 16 years after the curative bronchoscopic removal of the respective metallic foreign bodies)
- 7 Idem Charted experience in cases (Fbdy 631 to 1155) at the Bronchoscopic Clinic Proc Am Laryngol Rhinol & Otol Soc 1923 Also Ann Otol Rhinol & Laryngol 1924 xxxiii 1924
- 8 JACKSON C TUCKER G and CLERY L H Arachnidic and other forms of vegetal bronchitis Atlantic M J 1925 xxviii 506
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- 19 McCRAE T Clinical features of foreign bodies in the bronchi Lumsden lectures before the Royal College of Physicians of London Lancet 1924 pp 732 787 838

While in some instances this may have been due to the differences in the kind or relative virulence of the bacteria with which the inspired foreign body was smeared before or during its sojourn in or passage through the mouth it more often seems to have been related to the nature of the substance itself. A few of the many interesting questions in this connection on which we are still working are

Do vegetal substances break down the barrier against pyogenic invasion?

Is there a germicidal action ionic or other in cases of metallic foreign body undergoing oxidizing corrosive processes in the bronchi?

These and other interesting phases of this subject were considered by the author in the Muetter Lecture and in other publications.

One point in support of the theory of a barrier to bacterial invasion by way of the bronchial mucosa is the very different clinical course run by suppurative processes due to septic emboli as compared to suppurations of foreign body origin. The sudden extreme prostration pallor dyspnea rapid pulse and profoundly toxic condition of the patient and the rapid breaking down of lung tissue associated with embolic suppurations would seem to indicate that the bacteria had got in behind a barrier that seems to have held in check the suppurations secondary to endobronchial foreign body invasion in all except the cases of vegetal foreign bodies such as peanut kernels maize watermelon seeds etc. in children. Even in the latter class of cases the removal of the foreign body usually results in such a rapid cure (usually only a few days) as to point strongly to a very efficient defense to invasion by the endobronchial route. The existence of a defensive mechanism against insufflated endobronchial infection efficient against certain organisms inefficient against others has been recently demonstrated on mice in the laboratory by Sullman (17). His findings as to the defensive power of the lung being unable to annihilate certain streptococci organisms would seem to confirm my opinion that metallic foreign bodies have a germicidal effect. In our hundreds of such cases there must have been many plentifully smeared with streptococci of various kinds and

of various degrees of virulence. Streptococci were found in most of the suppurative foreign body cases.

# CONCLUSIONS

1 Pulmonary suppuration starting endobronchially and due to the presence of a foreign body is when contrasted with embolic post pneumatic and post influenzal suppurations such a mild slow and restricted process and manifests such a tendency to prompt and complete recovery after removal of the foreign body as to suggest the existence of some sort of physiological or structural barrier against the invasion of suppurative processes by the endobronchial route.

2 The characteristics of foreign body suppuration mentioned in the foregoing paragraph are most marked in cases of metallic foreign bodies which seem to possess germicidal powers. The same characteristics are present in a less degree minus the germicidal powers in other kinds of foreign bodies. They are least apparent in the cases of vegetal foreign bodies but even in these the prompt recovery in almost all cases if the foreign body has not been long in the tracheobronchial tree is in marked contrast to lung suppuration of any etiology other than that of foreign body.

3 Complete recoveries in a long series of cases after foreign body suppuration of from 10 to 36 years duration with no treatment other than the removal of the foreign body is so different from the course of pulmonary suppuration of any other etiology as to call for a separate classification for suppurations due to endobronchial foreign body.

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- 4 *Idem*. Lung suppuration caused by prolonged sojourn of foreign body. *Med. Clin. N. Am.* 1923 1 999.
- 5 *Idem*. Bronchiectasis and bronchiectatic symptoms due to foreign bodies. *Pennsylvania M. J.* 1916 xix 807 (Now after 10 years these patients are living and well.)

TABLE I—DEATH RATE PER ONE HUNDRED THOUSAND POPULATION PERCENTAGE OF INCREASE AND DECREASE

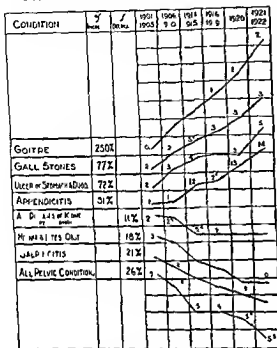


TABLE II—ECONOMIC IMPORTANCE OF DEATHS FROM APPENDICITIS AS COMPARED WITH DEATHS FROM OTHER IMPORTANT CONDITIONS

CAUSE OF DEATH	RE. OR. 44.50	RE. OR. 44.50
APPENDICITIS	83%	17%
CANCER	23%	77%
ORGANIC DISEASES OF HEART	20%	80%
DIABETES	29%	71%
GALL BLADDER	32%	68%
ULCER OF STOMACH & DUODENUM	45%	55%
HERNIA & INTESTINAL OBSTRUCTION	48%	52%

does the poorly trained operator undertake such operations as nephrectomy. In pelvic inflammatory processes it is firmly established that conservatism is indicated with confinement to bed, free administration of fluid and relief of pain through the use of anodynes such measures as these are stressed to the exclusion of the radical treatment advocated in former years.

On the other hand in many of the publications appearing in the medical literature the necessity of radical treatment of gall bladder disease is emphatically stressed along with this it is made to appear that the operative measures are comparatively simple. Even the layman is coming to consider the loss of his gall bladder the penalty to be paid for the crime of eructating and he must feel that his local surgeon so called is of little account unless he is capable of accomplishing the removal of this entirely superfluous and trouble making structure.

With ulcer we see the successive advance first the negation of possible benefit to be derived by medical treatment and the reliance upon the relatively simple operations of gastroenterostomy and pyloroplasty next the insistence upon these methods plus excision of the ulcer, and finally (or is it finally?) the contention that only by sacrifice of a large portion of the stomach or ulcer bearing area of the stomach and duodenum is the patient to be relieved of his sufferings. With appendicitis, there are many following the lead of Murphy who stress the importance of early

time the mortality rate from gastro intestinal ulcer increased 7 per cent that from appendicitis almost 31 per cent while the mortality rate accompanying thyroid disease showed the stupendous increase of over 250 per cent.

A careful analysis will I believe reveal that these differences are not the result merely of chance there may be found more plausible explanations for the decrease in the mortality rate accompanying the diseases included in the first group while no less definitely it may be explained why we are having a steady increase in the number of deaths due to gall stones ulcer appendicitis and diseases of the thyroid.

It has come to be fairly universally established that conservative operative methods play an important role in the handling of a patient suffering from acute intestinal obstruction. As regards surgical diseases of the kidney the diagnosis and treatment are left largely to surgeons of especial skill rarely

## THE MORTALITY IN IMPORTANT SURGICAL DISEASES, ESPECIALLY APPENDICITIS<sup>1</sup>

By A. MURAT WILLIS, M.D., F.A.C.S., RICHMOND, VIRGINIA

**I**N becoming fellows of the American College of Surgeons we pledge ourselves to place the welfare of the patient above every other consideration. At times unfortunately our efforts at best will secure for those relying upon our skill merely a measure of relief from their suffering, not infrequently on the other hand it may be granted to us either definitely to hasten the recovery of an invalid or actually to prevent a fatal termination of his illness. As surgeons we are especially privileged but likewise burdened with responsibility. Our patients are largely recruited from the young and middle aged; if our therapeutic efforts are successful there is the gratifying knowledge that we have preserved a life of value to its possessor and the community, if we fail we must face the fact that through our failure the patient has been denied long years of successful endeavor. Are our therapeutic attempts becoming more successful? Are more of the patients who are subjected to surgical treatment being definitely relieved of their ailments than was formerly the case? Especially is the mortality rate in surgical conditions declining with the increase in diagnostic and technical skill?

Reference to the published statistics from most of the leading surgical clinics in this country gives us an answer emphatically in the affirmative. One cannot fail to be impressed with the prevailing note of optimism in these reports. Judging from them the mortality rate accompanying the surgical treatment of diseases of the gall bladder, thyroid, gastro-intestinal tract and pelvic contents seems to be so rapidly approaching the vanishing point that we look forward to an early day when a failure of the patient to recover may be ascribed solely to that person's natural perversity and not to any dereliction on the part of the surgeon or fault in the method of treatment employed.

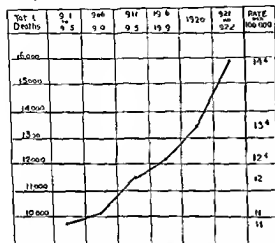
Unfortunately not all major surgery is carried out under the conditions which exist

in the large surgical clinics from which these optimistic reports emanate. Impressed by the brilliancy of the results obtained by these master surgeons and too often misled into believing that the technique of a difficult and dangerous operation is simple and free from risk to the patient, a constantly increasing number of surgeons in this country with little experience in such grave surgical procedures are resorting to operative therapy. Are all such operators meeting with the success that appears to crown the efforts of their more distinguished brethren? They rarely discuss their results in the pages of the medical journals, so that direct evidence as to what is being accomplished is generally lacking.

It is possible, however, to obtain some of this evidence by reference to the figures published through the Bureau of Vital Statistics. Here also we obtain information of a most comforting nature as regards the mortality rate associated with hernia and intestinal obstruction, surgical diseases of the kidney and pelvic inflammation. In the five year period 1901 to 1905 inclusive the deaths due to the first of these conditions were 13 per 100,000 population; in 1921 it had fallen to 10.7 per 100,000. In the period 1903 to 1911 the mortality rate from surgical diseases of the kidney decreased 21 per cent, while that due to involvement of the pelvic contents fell over 26 per cent in the same period of time.

It is distinctly disturbing on the other hand to find that with some other important surgical conditions not only do the data of the Bureau of Vital Statistics fail to confirm the belief as to a reduction in the number of deaths but on the contrary show that there is a steadily mounting rate from year to year. Thus in the five year period, 1901 to 1905 the number of deaths per hundred thousand from gall stones was 2.2; in the succeeding years it rose steadily until in 1922 the last year for which figures are available it showed an increase of 77 per cent. In the same period of

TABLE V—DEATHS IN THE UNITED STATES FROM APPENDICITIS TOTAL AREA FIGURED FROM BUREAU OF VITAL STATISTICS POPULATION 1900 90 MILLION, 1922 110 MILLION PERCENTAGE OF INCREASE FROM 1900 TO 1922, 30.9 PER CENT



Percentage of Increase from 1900 to 1922 - 30.9%

It is appalling to realize that the number of deaths annually from appendicitis equals all those from salpingitis pelvic abscess surgical diseases of the pancreas spleen and thyroid gall stones and ectopic pregnancy. The annual toll taken by appendicitis almost equals the combined total of intestinal obstruction gall stones and gastric and duodenal ulcer. Before the age of 45 more persons die annually from appendicitis than from cancer. Although the total death rate from cancer is 6 times that from appendicitis 80 per cent of the deaths from appendicitis occur before the

The mortality from appendicitis is 4.3 per 100,000. This means that with the present mortality rate in the United States there will be 6,000 deaths annually as a result of this disease. It is thought that if the death rate from appendicitis were reduced to 1 per 100,000, the annual toll would be 1,000 deaths.

TABLE VI—SURGICAL DEATH RATES FROM ACUTE APPENDICITIS RESULTS OBTAINED AT SEVERAL GREAT CLINICS

	Death rate percentage
Ochsner Professor of Surgery University of Illinois not reported in Clin Surg 1912 from 1901-1905	4.1
Personal communication Dept 1924	2.0
Deaver Professor of Surgery University of Pennsylvania reported in Ann Surg 1924	June—
Using method of Gatch 1901-1905	10.5
Using the Ochsner method 1910-1919	3.9
Gatch Professor of Surgery Indiana University reported in Ann Surg 1924 June rate for 1914	8.7

fiftieth year while only 1/4 of the deaths from cancer occur before the age of 50. Before the age of 60 there are about four thousand more deaths annually from appendicitis than there are from diabetes. Think of what these figures mean from an economic standpoint. The vast majority of those who succumb to appendicitis are lost during their productive years those who die from cancer or diabetes have in most instances passed the stage of usefulness.

# CONCLUSION

Destructive criticism is of small value unless it prepares the way for subsequent improvement. The presentation of facts which has just been made indicates that something is radically wrong with the modern surgical treatment of certain important conditions. Can this be remedied? It would seem that the first step would be the appointment by the American College of Surgeons of a commission composed of the leading surgical teachers of this country the function of this commission being to direct a thorough investigation of the whole question with a view to effecting some degree of standardization of the methods of treatment of these diseases regarding which at present there seems to be such a complete lack of agreement.

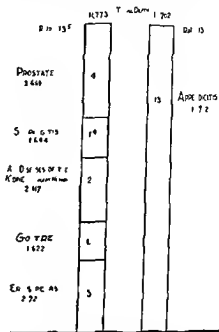


TABLE III—MORTALITY FROM APENDICITIS  
COMPILED FROM 1921 STATISTICS

	Rate per 100 000
Ulcer of the stomach and duodenum	4.9
Gallstones	3.9
Pancreas	0.6
Appendicitis 14.4 per cent	
Splen	0.3
Gout	2.7
Ectopic pregnancy	0.5
Salpingitis and pelvic abscess	2.1

operation with removal of the appendix a procedure most to be commended in interval cases or early in the course of an inflammatory attack but one fraught with the most dire possibilities for the patient if rigidly adhered to in all cases of appendiceal involvement.

In a paper read before the American Medical Association Bernheim has recently called attention to some most pertinent facts in this connection. He says 'The operative deaths in the gouter work of Dr Crile are hardly more than 1 per cent the deaths following upon the gall bladder and common duct work at the Mayo Clinic in 1923 were 5.6 per cent Deaver in his surgery of the upper abdomen reports 597 operations for benign disease of the stomach with 20 deaths. Balfour just recently reported 74 partial gastrectomies with one death. Does anyone believe that surgeons in general have any such results as these? But it is the example and the teaching of men of this caliber that influence less able surgeons to undertake serious and complicated operations. A subtotal thyroidectomy in the presence of exophthalmic goiter may never be serious to one with Dr Crile's amazing skill and vast experience a partial gastrectomy may be simplicity itself to Dr Balfour similarly equipped. The removal of a normal appendix from a slim young girl may present no serious difficulties even to our occasional operator the removal of a perforated appendix in the presence of peritonitis from a corpulent man of 50 is a different story. And yet the rank and file of the profession seem imbued with the idea that all appendectomies are simple. As a result even the layman views the separation from his appendix with no more uneasiness than that with which he looks forward to a visit to his dentist.

TABLE IV—APPENDICITIS IN RELATION TO  
OTHER SURGICAL CONDITIONS 1920—REG-  
ISTRATION AREA 83 PER CENT OF THE  
UNITED STATES

Another important factor is a lack of uniformity in the teaching as regards appropriate treatment in some of the last mentioned conditions. We see this strikingly illustrated in the case of gastroduodenal ulcer a small minority of surgeons incline to the belief that surgery is not indicated in all cases. The majority of the surgical profession contends that relatively conservative operative measures are demanded and suffice in most instances of ulcer while an increasing number is taking the attitude that both of the other groups are in error and that very radical operation is necessary.

No less lack of harmony is apparent concerning the opinions as to appropriate treatment of appendicitis. Representing one extreme are the followers of Ochsner who advocate conservative measures standing for the other are those who believe in operation on every patient as early as he is seen (which may not be early in the course of the disease) with removal of the appendix.

per cent erythrocytes numbered 4,840,000 and the leucocytes 7,300. The blood urea was 46 milligrams for each 100 cubic centimeters of blood. Clinical and roentgenographic examinations of the chest were negative. Proctoscopic examination revealed an immobile sigmoid.

A diagnosis of intestinal obstruction was made and operation was performed February 18, 1925. All loops of bowel were found to be greatly distended. The location of the lesion was not determined. Caecostomy was performed and immediately large quantities of fluid drained off. The patient's condition was not materially benefited by this procedure and she died 5 days later.

At necropsy the cause of the intestinal obstruction was found to be diverticulitis of the sigmoid which had produced a large mass in the pelvis and had almost completely obliterated the lumen of the bowel (Fig. 1). The liver weighed 1,549 grams; its surface was smooth, light reddish brown and on section the markings were regular and distinct. The common and hepatic ducts were moderately dilated. The dilatation of the hepatic duct was proportionately increased as it entered the hilus and extended into the parenchyma of the liver. In the hepatic duct at the point where it entered the hilus of the liver there was a stone about 1 centimeter in diameter. After removal of this stone the course of the hepatic duct was followed into the parenchyma where 10 or 12 other stones were found varying from a few millimeters to 1 centimeter in diameter. One large branched stone resembling the branched stones was found in the pelvis of kidneys from 4 to 5 centimeters from the hilus of the liver. This stone was lodged in a dilated intrahepatic duct. Analysis of the stones showed that they were composed almost entirely of cholesterol.

The question naturally arises whether these stones had their origin within the liver. There is a possibility that some of the debris from the crushed stones at the time of the first operation was forced into the liver by irrigation of the ducts. Erdmann has drawn attention to this occurrence. However there can be no reasonable doubt that the large calculi found in the liver formed there and increased in size regardless of the origin of their nuclei. French says: Gall stones may be found in any part of the excretory apparatus of the liver from the roots of the hepatic duct at the margins of the lobules to the termination of the common duct. Gall stones in the interior of the liver are rare. Usually the concretions are in the form of small brown or black grains which may fill the ducts. Sometimes they are large branched and coral-like. Cysts may develop around the stones.



Fig. 1. Portion of the liver showing stone in intrahepatic duct.

Naunyn maintains that bilirubin calcium calculi are frequently formed in the intrahepatic ducts and usually occur in thick, greasy, brownish black bile.

There are not sufficient data to form an estimate of the frequency of intrahepatic stones. Beer in 1904 dissected 250 livers of patients who had died from cholelithiasis and found intrahepatic stones in 6 cases. According to Murchison intrahepatic stones rarely occur in the absence of obstruction of the common duct. Rolleston says that the condition is very rare; he saw only 1 case that of a man who died from diabetes due to secondary pancreatitis.

The case reported by Vachell and Stevens indicates that intrahepatic stones do not come from the gall bladder. In this case a man aged 52 had had attacks of gall stone colic for 29 years but had never been jaundiced until the last attack. He was deeply jaundiced and the liver was enlarged. He died while under observation. At necropsy the liver weighed 2,750 grams. There was an abscess between its upper surface and the diaphragm. Its entire surface was covered with small projections caused by underlying calculi. It contained many tiny abscesses. The gall bladder was of normal size, not inflamed and did not contain either stones or bile. The hepatic duct and upper end of the common duct were markedly dilated and contained more than a hundred stones. The intrahepatic ducts were greatly dilated and contained calculi, mucus and bile. No part of the liver was free. Five hundred and twenty calculi were counted, the largest of which was

# INTRAHEPATIC CHOLELITHIASIS<sup>1</sup>

By E STARR JUDD MD FACS AND WERNE G BURDEN MD ROCHESTER MINNESOTA  
 Dated 15 JUNE

**I**T has long been known that stones occur in the intrahepatic ducts but the condition is uncommon even in published necropsy reports. The practical significance of biliary calculi in the ducts of the liver is not of much consequence from a surgical standpoint because of the rarity of the finding. Nevertheless it must be kept in mind as an occasional cause for recurrence of symptoms after operations on the gall bladder and ducts. In most of the reported cases the symptoms were severe and at operation or necropsy the lesions of the liver and ducts were extensive. The frequency of stones in the gall bladder and the common duct their less common occurrence in the hepatic duct and their almost complete absence from the ducts within the liver have led to the assumption that all stones form in the gall bladder. It is extremely rare for stones to reform in the common duct after their complete removal. The small bits of gravel which sometimes form in the liver probably pass through the ducts without difficulty.

**CASE 1** A woman aged 30 was admitted to the clinic October 20 1913 Her chief complaint was pain in the right upper quadrant of the abdomen For 10 years she had had repeated attacks of pain below the right costal margin radiating to the right shoulder The attacks were severe enough at times to require morphine for relief She was troubled a great deal by indigestion and occasionally after meals became nauseated and vomited She had never been jaundiced For 3 days preceding her visit she had had almost constant severe distress and vomited every 2 or 3 hours She was obese weighing 105 pounds

On examination there was no evidence of jaundice. Tenderness was present over the region of the gall bladder. Examinations of the urine and blood were negative. Gastric acids totaled 70 and the free hydrochloric acid was 60. Roentgenological examination of the stomach was unsatisfactory.

The patient was operated on October 24, 1913 at which time 4 large stones were found in the common duct and 3 in the hepatic duct. They were crushed in removal. The gall bladder was greatly thickened and adherent to the pylorus when cut away it left a thick adherent patch that caused a certain amount of obstruction of the pylorus. The

common duct was greatly thickened and adherent to the stomach duodenum and gall bladder. Following crushing and removal of the stones the ducts were washed out and probes and scoops passed into the duodenum. The gall bladder was removed and a catheter was sewed into the common duct for drainage. The operation was very difficult. Drainage of the wound was provided for by gauze and rubber tissue. The catheter was removed from the common duct on the ninth day. The patient's convalescence was uneventful and she was dismissed from the hospital on the nineteenth day.

The patient was seen again December 10, 1964, at which time she complained of occasional neurologic pain over the liver radiating to the right shoulder and down the right arm. In the preceding 2 months she had had periods of feeling sick which were not related to meals and for 10 days she repeatedly vomited large quantities of foul dark material. She complained of soreness in the epigastrium and below the right costal margin. There had been no severe pain or colic. She returned home under medical management.

May 31 1916 the patient reported that she had felt well until 6 weeks before when the attacks of vomiting recurred and continued at irregular intervals There was also some soreness below the right costal margin The systolic blood pressure at this time was 148 and the diastolic 90 Her weight was 155 5 pounds Examinations of the urine and blood were negative The gastric acids totaled 80 and the free hydrochloric acid was 24 there was retention of 700 cubic centimeters Roentgenological examination of the stomach revealed an obstructive lesion at the outlet

Operation June 9, 1916 showed the pyloric obstruction to be due to adhesions from the former operation. The liver was apparently in good condition. A posterior gastro enterostomy was performed. Following this the patient recovered satisfactorily and was dismissed from the hospital on the eleventh day.

February 16 1924 the patient again came to the clinic. She had had no trouble for 8 years until 10 days before admission when she became nauseated vomited and suffered from generalized abdominal pain which was especially severe in the epigastrium and left flank. The abdomen became distended. Diarrhoea was present at the onset of the attack but this subsided after 3 days under the influence of medicine. Gas could be passed by the bowel. Vomiting and abdominal pain continued after her admission to the hospital and repeated gastric lavage was carried out. She was still very obese. The abdomen was uniformly distended and tender. Urinalysis was negative. The haemoglobin was 80

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## A NEW METHOD OF DEMONSTRATING MEDIAN NERVE LESIONS

BY DENNIS CRILE M D CHICAGO

It is conceded by many writers that vasomotor secretory and trophic changes may and often do accompany peripheral nerve lesions. Evidences of this are cyanosis, edema, redness, and congestion of the area affected by the nerve. Tinel (2 p 21) says that vasomotor disturbances are practically inevitable in all nerve lesions. He also states:

In all cases the distribution of the vasomotor disturbances is exactly spread over the cutaneous region of the affected nerves. Cyanosis indicates vasomotor paralysis acting upon the vasoconstrictor apparatus. It is exaggerated by a dependent position and by cooling; it rapidly diminishes and disappears if the limb is placed in an elevated position. These phenomena show the loss of tone of the vasoconstrictor muscles in the paralyzed region.

Redness or cyanosis of the skin may in certain cases reach an extreme degree. For instance, we find the index finger in certain irritations of the median and the little finger in certain lesions of the ulnar assume a red wine coloured, edematous and shiny aspect.

No mention has been found in the literature of the distinct phenomenon cited in the following case reports.

### REPORT OF CASES

CASE 1. L. M. a young woman suffered a fracture of the lower end of the radius and ulna. The fracture was reduced and a cast applied the day of the injury, and for the following 24 hours the patient experienced great pain over the median nerve area. Apparently there was ischemia of the hand and wrist while the cast was in place. The pressure was relieved.

Three weeks after the accident, when we first saw the patient, there was malunion of the fracture and

complete sensory paralysis over the median nerve area in the hand with a positive Tinel's sign 2 inches above the wrist over the median nerve trunk. No vasomotor disturbances were evident but there was profuse sweating over the anesthetic area and a painless perionychium of the index finger, the result of an accidental wound while the patient was manicuring her finger nail, which was not noticed because of the anesthesia. She was advised to soak the hand in hot boric acid solutions and to apply large hot boric acid dressings to it, kept hot by the use of the therapeutic light. All splinting was discontinued, active and passive motions encouraged, and after a few days Bier's hyperemia was employed 3 times daily, the cuff of a sphygmomanometer being used with the pressure at 80 millimeters mercury, which was the patient's diastolic pressure.

### DESCRIPTION OF PHENOMENON

The patient noticed that after the hyperemia had been established for 2 or 3 minutes the hand assumed a peculiar appearance. The thumb and first 2 fingers and the radial side of the ring finger gradually became cyanosed and tense, the color extending over the thenar eminence and outlining the sensory distribution of the median nerve. The rest of the ring finger and the little finger and the remaining area of the palm became a mottled red. As long as pressure was maintained the appearance of the hand remained unaltered. When the pressure was removed the hand gradually assumed its normal color. This phenomenon was verified by examination and found to be constant, appearing with certainty within 5 minutes after the hyperemia was established. A more detailed description follows: after 1 minute of pressure the anesthetic area became red and the sensitive area mottled; after 3 minutes the anesthetic area became

4.38 centimeters long. Many of them were faceted. The calculi contained 18 per cent of cholesterol and 38.9 per cent of calcium bilirubin. Lenhartz also reported a case in which stones were found in the liver but not in the gall bladder. Chopart observed a patient whose liver contained so many concretions that it could not be cut with a scalpel.

The gross appearance of the liver in the various cases was greatly altered. The liver was usually enlarged. The stones sometimes became inclosed in firm fibrous cysts which might project from the surface. Suppurative cholangitis with the formation of abscesses was not uncommon.

In operating for stones in the common duct it is not very uncommon to find stones in the hepatic duct as far up as can be explored with a probe. The condition is ordinarily thought to be produced by the stagnant and infected bile behind a stone in the common duct.

The actual finding of stones in the liver at the time of operation is a great rarity and in this connection the experience of Lewisohn is unique. His patient was a man aged 31 whose liver was large and nodular and on its inferior surface was a perforated abscess cavity containing stones. One of the nodules on the upper surface of the liver was opened and found to contain stones. The gall bladder contained stones. Cholecystectomy was performed. The patient recovered but a biliary fistula persisted until it closed spontaneously after 8 months. The stones were analyzed and found to contain 48.11 per cent cholesterol.

In most of the cases of intrahepatic stones which have been reported the patients were acutely and gravely ill and they were often deeply jaundiced. Rolleston says that these calculi almost necessarily set up jaundice and a good deal of pericholangitis. On the other hand Murchison says that the symptoms are obscure, that jaundice is absent and the liver enlarged and that pain or colic may occur. It is common knowledge that the severity of symptoms is not necessarily proportionate to the size or number of stones in the common duct. In fact it is not unusual to find a large stone in the common duct

which has never given rise to jaundice. In 1842 Thomson called attention to what was apparently well known at that time that the degree of obstruction produced by a calculus in the gall duct is not uniformly proportional to its size. A large branched stone forming a complete cast of the renal pelvis is sometimes seen in a kidney with good function. We have observed a solitary kidney which contained a large staghorn calculus; the patient was seemingly in good health and renal function was adequate.

Oertel reports the necropsy on a man who died following drainage of the bladder for hypertrophy of the prostate. The gall bladder and ducts were markedly dilated and contained thin bile. A stone 1.5 by 3 centimeters was found at the ampulla of Vater and the common duct at the papilla was 3 centimeters in diameter. There were also many stones in the upper portion of the common duct and in both hepatic ducts. The common duct was 4 centimeters in diameter. The man was not jaundiced and there was no evidence in the liver of previous obstructive jaundice.

In the cases in which a chemical analysis of the stones was made they were found to contain chiefly bilirubin, calcium and a smaller amount of cholesterol.

The unique features in the case which forms the subject of this report are: The finding of many large intrahepatic calculi in a liver which was grossly normal more than 11 years after cholecystectomy and removal of numerous stones from the extrahepatic ducts and the presence of this condition without the occurrence of jaundice or any clinical evidence of hepatic insufficiency, the condition being an incidental finding in a patient who died from intestinal obstruction.

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**CASE 4** In this case of a man with a fracture of the radius caused by a fall 18 weeks before presentation no anæsthetic area of the hand was discernible although there was some atrophy of the muscles supplied by the median nerve and the patient stated that there had been a sensory paralysis from which he had recovered. The color phenomenon could not be elicited as was anticipated since sensation had returned.

The cutaneous symptoms which may be applicable in the cases cited in this report may be partially explained by the fact that irritation of the nerve trunk in the wound is transmitted by the centrifugal fibers to the sensory corpuscles of the skin. These causes affect the vascular tension generally and particularly the groups of small capillaries which abound in the papillæ of the skin the glomeruli of the glands and the sensory corpuscles (1 p 86).

The appearance of the sign which we are describing seems of special value in cases of causalgia which according to S Weir Mitchell is a group of symptoms characterized chiefly by intense burning pain and irritation referable to the nerve fibers affected by lesions of the nerve trunks. Benisty (1 p 87) says 'The intense pain and the vaso motor and trophic changes accompanying it are due to what appear to be trivial lesions of the nerve trunks probably inflammatory in nature. We think that these lesions particularly affect the vasomotor secretory and trophic fibers of all the tissues served by this nerve (median). The stronger fibers such as the motor are only slightly interfered with by this irritative process as may be seen by the paresis tremor and twitching other fibers such as the secretory may in some cases be entirely destroyed but the great majority undergo a kind of irritation which reacts on the capillaries of the papillæ of the skin on the sensory corpuscles the skin glands the subcutaneous cellular tissue the joints and bones etc resulting in the complex of symptoms described by Weir Mitchell under the term causalgia.

The close proximity of nerves and arteries leads one to suspect that injuries to the nerves might cause vascular disturbances. Benisty (1 p 110) states 'When there are pronounced vasomotor changes with signs of edema



Fig. 3 Case 1. Photograph taken 5 weeks after the nerve lesion occurred. Note the fairly sharp line of demarcation on the ring finger.

of the fingers, glossy, cyanosed or purplish skin and trophic changes consisting in ulceration and deformity of the nails an associated vascular lesion should be suspected because on account of the close proximity of nerves and arteries this lesion is very common.

The median nerve is supplied with a branch of the brachial artery which penetrates it down the length of the arm. In the forearm the ulnar supplies it with the artery of the median which accompanies the nerve along its whole course. The branches of the median nerve in the hand are supplied by a number of arterioles independent of those already mentioned.

Benisty further states 'In partial paralysis uncomplicated by any vascular lesion vasomotor and secretory troubles are considerable. The skin is cyanosed it is colder and perspires more than the healthy part of the hand (1 p 67).

It is easy to define the share this system (sympathetic) takes in the case of the sciatic, as it is known that most of the vasomotor fibers of the lower extremity accompany this nerve. This fact has been confirmed by Claude Bernard's classical experiment in which he performed section of the sciatic nerve on a rabbit and afterwards noticed active vasodilatation of the blood vessels of the foot with local rise of temperature. Physiological experiments on the upper extremity have not been as numerous or as definite (1, p 82).



Fig. 1 Appearance of hand in Case 1 a few minutes after application of the sphygmomanometer cuff the pressure being maintained at about 80 millimeters mercury at time of presentation 6 weeks later and 10 weeks later  
 /// = color    \\\ = anesthesia



Fig. 2 Appearance of hand in Case 2 a few minutes after application of the sphygmomanometer cuff the pressure being maintained at about 80 millimeters at time of presentation 4 weeks later and 8 weeks later  
 /// = color  
 \\\ = anesthesia

quite cyanotic after 5 minutes the anæsthetic area became very cyanotic the sensitive area plainly mottled the anæsthetic area cold and the sensitive area warm after 20 minutes, the anæsthetic area became extremely cyanotic and the sensitive area darkly mottled

Under conservative treatment and a continuation of these remedies the evidence of median nerve paralysis gradually and steadily subsided sensation returned around the base of the hand and gradually extended to the finger tips Six weeks later sensation had returned to the palm and the area of color change had decreased correspondingly Ten weeks later the color phenomenon could still be elicited but there was no remaining evidence of median nerve paralysis except anæsthesia over the tips of the thumb index and middle fingers as shown in Figure 1

CASE 2 P. L. a young man injured his wrist and the same phenomenon as that noted in Case 1 was observed The hand was completely paralyzed over the median area Operation was decided on immediately before operation and while the patient was anæsthetized the blood pressure apparatus was pumped to 80 millimeters The first 3 fingers became cyanotic and the last 2 fingers and half of the palm became a mottled red (Fig. 2) With the release of pressure the hand became normal in color

Operation There was no vascular lesion and the arteries and veins were found intact An incision was made along the course of the median nerve in the forearm extending down to the palm The nerve trunk was traced 4 inches above the wrist and into the palm to its arborization This necessitated the complete division of the anterior annular ligament No lesion in continuity was found but at the site of the ventral deformity of the radius about 1 $\frac{1}{2}$  inches from its lower end there was evidence of slight pressure upon the trunk and a few points were found at which the neural sheath was adherent to

the surrounding tissues The adhesions were freed and the neural sheath opened and dissected away from the trunk of the nerve for a distance of about 3 $\frac{1}{2}$  inches The wound was then closed

There was no essential difference between the progress of this case and that of the preceding one The color phenomenon produced by constricting the arm at diastolic pressure was more definite than in the preceding case both before and after the operation corresponding precisely to the anæsthetic area and gradually diminishing both in intensity and extent as sensation returned

Four weeks after the operation there was a return of sensation as far as the terminal phalanges in all fingers and 8 weeks later sensation was unimpaired and no color phenomenon could be produced

CASE 3 In this instance the patient had a compound fracture of the elbow joint and a division of the ulnar nerve at the elbow The patient was seen 8 months after the ulnar nerve had been sutured Tinel's sign was present to the base of the fifth finger with anæsthesia of the fifth finger and one half of the fourth finger The ulnar area of the hand proper had recovered The ulnar nerve was regenerating at the rate of about 1 millimeter a day the production of venous retention by means of a sphygmomanometer cuff at diastolic pressure seemed to produce a very slight fairly discernible difference in color between the anæsthetic and quiescent areas This change was so indefinite that several observers could not agree as to its presence but all noticed a debatable change in color In this case it is possible that the vasomotor fibers were already functioning in the five fingers and that the sensory fibers had not yet come to their full properties a reversal of the comparative progress of sensation and vascular control noted in Case 1 However this case was practically one of recovered nerve lesion so that the sign was not expected to be positive

## SPLENECTOMY AS A THERAPEUTIC MEASURE IN THROMBO-CYTOPENIC PURPURA HÆMORRHAGICA

BY ALLEN O. WHIPPLE, M.D., F.A.C.S., NEW YORK CITY

THE etiology of purpura hemorrhagica is not known; the pathology is ill defined; the differential diagnosis is at times difficult. It is not strange that the therapy should be empirical; empirical to this extent at least, that nothing is done either by transfusion or splenectomy, the two recognized measures in the treatment to remove a known cause.

The rationale of splenectomy consists in the fact that many of the cases of chronic purpura have a splenomegaly and that inasmuch as removal of the normal spleen results in an initial increase in blood platelets, the procedure seems logical in a disease characterized by a low platelet count. Credit for the suggestion of splenectomy as a cure for purpura hemorrhagica is usually given to Kaznelson of Prague, who did the first splenectomy in this disease in November 1916.<sup>1</sup> It is but fair to state that Dr. Alfred Hess of New York City suggested this therapy in 1915. In a communication from Dr. L. W. Peterson,<sup>2</sup> he says: "I find in looking up my record of S. M. that Dr. Hess saw the patient with me in 1915 and suggested that we do a splenectomy to see if it would correct the blood dyscrasia. The patient left the hospital August 16, 1917 (See Case 71 in this paper). Dr. Hess later in 1917 emphasized the possible advantages of splenectomy in a paper entitled, 'A Consideration of the Reduction of the Blood Platelets in Purpura.'<sup>3</sup>

There are two very good reasons for the enthusiasm in the profession regarding the operation of splenectomy in so-called thrombocytopenic purpura or idiopathic purpura: first because of the failure in many cases of medical measure including transfusion to control the main symptom, bleeding; second because in the majority of cases of chronic

purpura of the amazing immediate improvement both subjective and objective. This has resulted in a popular conception in the profession that splenectomy is an infallible remedy, so it is being applied rather indiscriminately to cases improperly selected and not always correctly diagnosed. In the English and American literature individual cases or at the most small groups have been reported without adequate follow-up notes. As yet the collected cases with late results have not been reported. It is with this purpose in mind that the writer has reviewed the literature and as a result of a questionnaire sent to members of the American Surgical Association he has added some 29 unpublished cases, including 1 of his own, making a total of 80 cases of purpura hemorrhagica in which splenectomy was used as the therapeutic measure.

An attempt will be made (1) to point out certain evidence that the disease called thrombocytopenic purpura is not a distinct entity but a phase of a deranged reticulo-endothelial system and that merging into this group are other forms of hemorrhagic disease not benefited by splenectomy; (2) to differentiate the type of disease suitable for splenectomy; and (3) to evaluate the final benefit of splenectomy in the chronic type of the disease.

In the study of diseases of the blood, disturbances of the blood-forming apparatus and the blood-destroying apparatus or both must be considered. Intimately associated with the blood-destroying apparatus, in fact a large part of it, is the system of cells named by Aschoff<sup>4</sup> the reticulo-endothelial system—a term much in use in the literature at the present time. One particularly interesting function of this system of cells is to devour the used up red and white corpuscles and the platelets of the circulating blood and to metabolize them. The cells are found in the sinuses of the lymph nodes, the blood sinuses



"Vasomotor disturbances are the most characteristic disturbances and lead us to suspect that an arterial wound is present in addition to the lesion of the nerve. When they are very pronounced the skin takes on a reddish purple tint as if it had been exposed to the cold for a long time or else it is bluish black in colour and in the latter case it is accompanied by that succulent appearance already mentioned. The least puncture in that case such as the pin prick *one gives in testing sensibility* makes the blood gush out. Sometimes these vasomotor disturbances are generalised in the hand or foot in other cases they are localised in one or in several fingers (very often the index finger at other times in the three last) and they are then still more noticeable. In other cases particularly in those where vascular obliteration is compensated by collateral circulation the vasomotor troubles are less pronounced and consist only in a reddish tint of the skin of the whole extremity of the limb but from time to time the patient passes through real attacks of asphyxia of the extremities. The local temperature is always lowered sometimes several degrees in comparison with the healthy side. The hand and fingers are cold whatever the external temperature may be. The disturbance of objective sensibility consists in complete extensive anaesthesia of segmentary type with constantly changing localisation and bearing no relation to the peripheral distribution of the nerve filaments. This anaesthesia sometimes occupies the extremity of all the fingers sometimes the whole of the three last fingers or all the index finger or the entire hand or foot (i pp 215 and 217)

This new method permits us to produce an immediate and positive definition by color of the areas affected by some nerve lesions. The appearance of these areas is very similar to their appearance in some cases of longstanding nerve lesions as has been described above.

#### CONCLUSIONS

The value of this sign seems to be in its objective qualities. It is a sign which cannot be feigned and as such is of great value in differentiating the malingerer from the unfortunate. It presents the means of delineating in a graphic manner cutaneous areas the nerve supply of which is blocked. It supplements the tactile tests and should be a useful means of studying the physiology and pharmacology of vasomotor control. Its value lies in the facility with which it may be produced in recent cases contrasted with the length of time required to produce visible vasomotor disturbances as they appear in chronic cases.

We realize that the appearance of this sign in 2 cases does not establish it as a constant or unvarying sign of peripheral nerve lesions and that therefore the absence of this sign is of no importance. However the presence of this sign establishes objective evidence of a nerve lesion.

We have not had opportunity to test for this sign in complete division of the nerve. This report will be supplemented by the report of a larger series of cases at a later date.

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tory confirmed Rouget's long forgotten findings and named these cells Rouget cells after their discoverer. Aschoff disputes the findings of Vimtrup as regards the contractility of the cell body but considers them a unit of the reticulo endothelial system. It is conceivable that these Rouget cells stimulated by the same agent that is active in other parts of the reticulo endothelial system might disturb the permeability of the capillary wall to the blood stream facilitating the escape of blood into the tissues.

In a case of acute purpura hæmorrhagica the writer undertook with Dr M. J. Schoenberg to study the capillary network of the skin of the forearm while applying the Hess tourniquet test. It happened that at the time the patient did not show the positive test so that the production of petechiæ could not be visualized. The patient was very anæmic at the time and had a low blood pressure so that the identification of the skin capillaries was difficult.

The efficacy of splenectomy in purpura depends upon whether the major part of the thrombocytolysis is taking place in the spleen and upon the inciting cause or agent. In the so called chronic type of the disease with the spleen hypertrophied this would seem to be the case for it is in this type that removal of the spleen produces brilliant and lasting results.

That the normal spleen destroys thrombocytes is favored by the fact that there is practically always a sharp rise in the platelet count after splenectomy both in experimental animals and in clinical cases. But there are other definite factors that cause a thrombocytolysis either by direct action or by overstimulating the elements in the reticulo endothelial system that normally destroy thrombocytes. Cole<sup>1</sup> in 1907 first demonstrated that the platelets could be destroyed in one animal by injecting into it antiplatelet serum developed in another animal. Other workers have reproduced the clinical signs and the blood changes characteristic of purpura by subcutaneous injections of antiplatelet serum.

The same results have been obtained by injecting the by products of streptococcus and

pneumococcus. And it is known very definitely that the lighting up or the failure to drain of a streptococcus focus as in an antrum or sinus infection will result in a great diminution of the thrombocytes, and an appearance of petechiæ and purpuric bleeding. It may be that the poisons from bacteria may stimulate some element in the reticulo endothelial system to an excessive thrombocytolysis. This factor of infection is a most important one and may be the underlying cause even in the so called idiopathic purpura cases.

#### THE TYPE OF CASE SUITABLE FOR SPLENECTOMY

Purpura hæmorrhagica is characterized by five fairly definite findings.

- 1 A low or absent platelet count
- 2 A prolonged bleeding time
- 3 A failure of the clot to retract,
- 4 A normal clotting time
- 5 The appearance of petechiæ in the skin

of an extremity below the tourniquet applied so as to shut off the venous but not the arterial flow.

It differs from hæmophilia in that there is no history of bleeders in the family, it is not inherited. It is more common in women than in men. The blood clotting time is normal, petechiæ and hemorrhages are not so characteristically associated with trauma. It is at times difficult to differentiate from an acute aplastic anæmia but in purpura there is almost always a leucocytosis as compared to a leucopenia in aplastic anæmia.

The main point to decide once the diagnosis is made is whether the patient has the disease in the chronic recurrent form or whether it is an acute fulminating type. The former type is usually promptly and permanently cured by splenectomy, the latter type is seldom helped by the procedure. The chronic recurrent type of the disease gives a history of repeated attacks of petechiæ purpuric areas irregular bleeding from gums and in women menorrhagia. Bleeding is as a rule not very profuse and is not so apt to occur into the alimentary canal or into the parenchyma of the organs. The fact that splenectomy cures would imply that the major disturbance

of the spleen, the capillaries of the liver lobules the capillaries of the bone marrow, in the connective tissue as wandering cells and in contact with capillaries as Rouget cells. A striking morphological characteristic of the cells of this system is their vital staining namely the uniform granular deposition of a dye stuff in solution in the living cell bodies without in any way injuring them.

It is evident that a system of cells such as the reticulo endothelial system whose particular function is the digestion of blood cells may show variations of dysfunction both in degree and in the distribution of the site of the dysfunction. Thus one form of dysfunction would seem to be definitely limited to the reticulo endothelial cells of the spleen as in hæmolytic jaundice. Overactive destruction of red cells in this organ results in an anemia and jaundice. Removal of the spleen because the derangement is limited to this organ results in a cure.

Another form of dysfunction such as is found in Gaucher's disease is not limited to the spleen, but the altered reticulo endothelial cells are found in lymph nodes and bone marrow and liver. Splenectomy in this disease can remove only the major part of the lesion.

Inasmuch as the reticulo-endothelial cells get rid of the jaded or excessive blood platelets it is logical to think that in a disease such as purpura hæmorrhagica in which a low or absent platelet count is a prominent feature some part of this system is overactive. If the overactive cells are largely limited to the spleen its removal would promise immediate good results and probably permanent results. But if the entire reticulo endothelial circle is involved splenectomy would do no more than remove a part of the overactive apparatus and such a major procedure in the presence of a profound vascular disturbance as in the acute form of purpura is extremely hazardous to the patient.

In some of the blood diseases involving the blood forming apparatus there is apparently an associated disturbance or overactivity of the blood destroying or reticulo endothelial apparatus as well. Thus in some cases of aplastic anemia and in certain of the leucæmias there is noted a marked decrease in

blood platelets and a tendency to bleed. Splenectomy in these conditions is illogical because the lesion is not limited, even partially, to this organ.

The relation of decreased blood platelets to purpura hæmorrhagica is well recognized. Denys in 1887 first called attention to this fact. Whether this decrease in blood platelets is due to the failure of the megacaryocytes of the bone marrow to form new platelets or to an overactivity of the reticulo-endothelial cells in destroying them is still a moot question. The general opinion would seem to favor the theory championed by Karselson that the blood platelets are formed in normal numbers but are destroyed by overactive phagocytosis in the spleen and other parts of the reticulo endothelial system.

It is furthermore generally agreed that the blood platelets are the most important formed elements in the blood clotting phenomenon and that they produce a thromboplastin substance. The severity of the bleeding in purpura would therefore seem to depend upon (1) the intensity of the thrombocytolysis (2) the extent to which certain cells of the reticulo endothelial system engaged in thrombocytolysis are distributed in spleen liver bone marrow and lymph nodes (3) the permeability of the capillaries to the circulating blood. This latter consideration is the least understood of the three. The decrease in platelets may favor the ready egress of red cells through the potential spaces between the living endothelial cells of the capillaries. On the other hand the Rouget cells classed by Aschoff<sup>1</sup> as reticulo endothelial cells may play an active part in the permeability of the capillaries. Krogh<sup>2</sup> and his pupils have made the most valuable contributions to the study of the capillary system. Rouget<sup>3</sup> in 1873 first called attention to the existence of peculiar contractile cells on the walls of capillaries, whose ramified prolongations of cell body protrude irregularly encircling the capillary wall. Vimtrup<sup>4</sup> working in Krogh's labora-

<sup>1</sup> Aschoff L. Lect. re. Pathology. New York: P. Hoeber. 1914.  
<sup>2</sup> Krogh A. The Anatomy and Physiology of Capillaries. 1st ed. New York: 1919.  
<sup>3</sup> Rouget J. C. Ch. 373.  
<sup>4</sup> Vimtrup B. Ztsch. f. d. Anat. lev. 5.



REPORTED CASES OF SPINAECTOMY FOR THE ONCOCYTOMA NUCLEUS PULPUSAE IN MORI HACHIA

[illegible]

Case	Sex	Age	Onset	Duration	Course	Diagnosis	Prognosis	Remarks	Outcome
1	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
2	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
3	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
4	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
5	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
6	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
7	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
8	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
9	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
10	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
11	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
12	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
13	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
14	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
15	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
16	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
17	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
18	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
19	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
20	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
21	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
22	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
23	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
24	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
25	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
26	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good
27	F	15	1907	4	5	BP 120/80 HR 110 Wt 55.0	Good	BP 120/80 HR 110 Wt 55.0	Good

REPORTED CASES OF SPLENECTOMY FOR THROMBOCYTOPENIC PURPURA HEMORRHAGIC—Continued

C. No.	A. th. r. Operator	Sex	Age	Duration of symptoms	Bleeds from	Hgb	R.B.C.	Blood platelets	Clotting time	Bleeding time	Clot retraction	Histology	Blood field examination	Recurrent symptoms	Sp. = 1 in	Result
35	St. uile g (15)	F	64	C	yr	kin	85	36,000	20 m	2 m m	Slight	?	R.P. 4 h 57 oo Bleed 8 m m 34 m	Bleeding 2 mos	2 mos	Good
39	W. lid (42)	M	5	C	12 yr	Skin	?	9,000	Ex-5 mal	Ex-5 min	?	?	R.P. 4 55 04 oo 30 days 8 00 oo 9 mo 300 oo	No cure	9 mos	Good
4	H. m. a. (9)	P	8	A	4 d yr	Nose & tetanus	6	300,000	?	?	?	?	Died few hours after splenectomy	A. tony showed subject was a boy with a large spleen		Died
4	Engel (9)	F		C	9 yrs	Skin gums & nose	35	20,000	?	?	?	?	red, yellow & for meager B.P. 3 d 10 15 00 oo R.B.C. 45	recurrence of bleeding after 1 day	2 1/2 mos	Good
4	Engel (9)	M	9	A	3 days	Skin & bowels	76	45,000	3 1/2 m	3 hrs	?	?	P. 1 d 4 40 m 100 m	A. tony showed hemo phages in skin & spleen		Died
43	Engel (9)	M	44	A	3 d yr	Skin & bowels	44	90,000	4 1/2 m	?	?	?	P. 1 d 4 40 m 100 m	A. tony showed hemo phages in skin & spleen		Died
44	Engel (9)	F	7	A	2 days	Urticaria & gums		4,000	Ex-5 mal	1 min	?	?	R.P. 4 d 7 00 oo 3 d 15 00 oo 13 d 6 00 oo R.B.C. 3 mos 176 000 4,000,000	Severe nose-bleed & bleeding from that	3 mos	Good
45	S. chard d Williams (6)	F	8	C	?	Skin one	?	5,000	?	?	?	?	R.P. 6 h 4 1/2 oo 3 m 3 00 oo 3 mo 1 00 oo	P. 1 h 4 d bruises at 10 m	3 mos	Good
46	S. th. i. d W. H. ray (16)	M	9	C	?	Skin none	?	5,800	?	?	?	?	R.P. 6 h 4 1/2 oo 4 d 3 31 oo 4 m	Severe nose-bleed & bleeding from that	4 mos	Good
47	H. t. m. (48) H. t. m.	F	8	C	yr	Skin one	4	4,000	6 m m	6 min	N	?	R.P. 6 h 4 1/2 oo 3 m 3 00 oo 3 mo 1 00 oo	P. 1 h 4 d bruises at 10 m	4 mos	Good
48	H. h. (7)	F	46	C	6 mos	Skin one	?	4,000	6 m m	6 min	N	?	R.P. 6 h 4 1/2 oo 3 m 3 00 oo 3 mo 1 00 oo	P. 1 h 4 d bruises at 10 m	4 mos	Good
49	H. m. h. (27)	F	7	C	8 mos	Skin one	3	60,000	6 m m	6 min	N	?	R.P. 6 h 4 1/2 oo 3 m 3 00 oo 3 mo 1 00 oo	P. 1 h 4 d bruises at 10 m	4 mos	Good
5	V. t. t. (17)	F	8	C	?	Skin one	?	?	?	?	?	?	R.P. 6 h 4 1/2 oo 3 m 3 00 oo 3 mo 1 00 oo	P. 1 h 4 d bruises at 10 m	4 mos	Good







of the reticulo endothelial system is localized to the spleen.

The acute fulminating type usually gives no history of former petechia but there occurs sudden severe uncontrollable oozing of blood from mucous membranes and into the subcutaneous tissues and organs. Hæmateme is hæmaturia blood in the stools in severe form are more apt to occur. These cases do not respond to one transfusion as promptly as do the chronic forms but may require repeated transfusions before the bleeding stops. In one of the cases reported from the Mayo Clinic 12 transfusions were given in 40 days. These cases should be tidied over by transfusions until the bleeding has stopped and when built up splenectomized to prevent a recurrence.

In the 81 cases collected there were 8 cases operated upon during the acute stage with 7 deaths—all within a very short time after the completion of the operation. Of the 73 cases of the chronic form there were only 6 post operative deaths showing the relative safety of splenectomy in the chronic form.

There are certain features characteristic of the chronic type. The immediate return to normal bleeding time the abrupt sharp rise of blood platelets to 200 000 600 000 with a sharp drop within 2 to 60 days to normal or a low figure the clearing up of the muddy palor the disappearance of petechie and purpuric spots and cessation of bleeding from nose gums and uterus are the spectacular features. Perhaps the most important feature to the patient is the sense of well being felt within a day or two.

Kaznelson's first case splenectomized in 1916 has had no recurrence of symptoms of any sort. He reports two more cases 6 years after operation in one of which the result was good in the other fair. Beneke reports a 3 year result with no recurrence. Ehrenberg reports a 4½ year result with no recurrence. Fourteen cases are reported that have gone 4 year or more without recurrence of symptoms.

Kei man reports one case 1 year after operation without improvement.

Clopton reports a poor result in a case 1 year after operation the result of a tonsillar infection.

In a few cases there were later occasional nosebleeds and petechie.

Some of the cases were reported as having recurrences of petechia and purpuric spots following infections such as tonsillitis and influenza—supporting the etiological factor of infection.

Many of the cases followed showed a persistently low platelet count although there had been no recurrence of symptom.

Three cases have been reported as dying at intervals of 3 weeks to 18 months after splenectomy from intracranial hæmorrhage.

#### SUMMARY

Of the 81 collected cases there were

13 of the chronic type

8 of the acute

6 deaths in the chronic varieties

7 of the 8 acute cases operated upon died

Of the 61 followed cases

31 gave good results

4 fair

6 poor

Considering the brilliant immediate results and the restoring to normal living of the great majority of the cases of chronic purpura following splenectomy it may be said that this operation has contributed the greatest advance to the therapy of the purpuras but it must be remembered that these results are largely limited to the chronic variety. Furthermore it should be emphasized that the patients after splenectomy should be cautioned and guarded against infections in order to obtain the best results.

#### AUTHOR'S CASES

CASE 8 A V age 18 was admitted to the hospital first July 28 1907. His chief complaint was spot on the body which appeared 4 days ago. The family history showed no hæmophilia or purpura. There is no history of exanthemata. Patient had pneumonia at 5 and again at 11. He has had no rheumatism or sore throats occasional bronchitis. Five days before admission patient vomited three times. No blood. Four days before admission he noted faint fine red spots on the feet and legs. The next day the spots were higher on the body and arms and in the evening there were large ecchymoses on the body. The day before admission the urine was bright red. The findings on admission were epistaxis bleeding gums melena hæmaturia and

purpuric eruption no joint symptoms no abdominal pain fundi negative The blood count showed 3 200 000 red cells 12 200 white cells The differential count was normal Bleeding time 5 minutes clotting time 25 minutes No retraction of clot in 24 hours The platelet count was 280 000 Wasser mann reaction was negative Patient belonged to blood Group I The patient was relieved of all symptoms and signs noted on admission by transfusion of 350 cubic centimeters of citrated blood 1 week after admission No other treatment was needed He was discharged August 12 1920 5 days after transfusion with red blood cells 4 680 000 hemoglobin 84 per cent Bleeding time 2 minutes clotting time 6½ minutes clot retractile

*Interval history* Patient attended school regularly and noticed no bleeding or tendency to bleed on trauma no hematoma no melena

Patient admitted second time March 8 1921 On the morning before admission while dressing he noted small spots on the legs similar to those noted in July 1920 small purpuric vesicles on thighs trunk and in mouth small eruptions on legs and bleeding from gums He was given immediate transfusion of 250 cubic centimeters of citrated blood and two more of like amount during 2 months stay in hospital He had several nosebleeds and crops of purpuric spots It was thought that oil of turpentine minimis xv helped a little

Patient was followed in out patient department He remained well and free from symptoms until June 1923 The platelet count steadily rose to 50 000 Then he had a mild attack of nausea and purpuric eruption platelets 10 000 He was sent home to bed and became entirely well in a few days

He was admitted the third time October 11 1924 One month before admission he began to have bleeding from gums melena purpuric eruption nausea etc Treated for hæmophilia by injections of arsenic and iron He has been in bed for past 3 weeks and feels very weak The skin is waxy pale and there are many ecchymotic spots on the legs and body the teeth are dark colored The gums are bleeding A soft systolic murmur is heard at apex Red blood cells 2 030 000 hemoglobin 23 per cent achromia and stippling white blood cells 15 000 polynuclears 76 per cent platelets less than 20 000 Bleeding time 3½ minutes no clot retraction Vomitus and stools—guaiac 4 plus Five transfusions were administered the first of 1 000 cubic centimeters and the others of 500 cubic centimeters each of unmodified blood at weekly intervals There was a gradual but steady improvement with a gain of 3 kilos in weight Patient continued to have bleeding and eruptions from time to time so he was advised to go to the country for 3 weeks and return for splenectomy Red blood cells 4 100 000 hemoglobin 85 per cent on discharge December 3 1924

He was admitted the fourth time on December 26 1924 A transfusion of 400 mls of unmodified blood was given on day of admission without reac-

tion Red blood cells 5 712 000 Hemoglobin, 86 per cent platelets 6 000

Operation Splenectomy, December 27 1924 Patient had a good deal of shock for 1 day post operative and a rather marked fall of red blood cells to 3 060 000 but he soon rallied and has improved steadily ever since Color is good Purpuric eruptions have almost entirely cleared up Bleeding time has come down from 11 minutes to 2 minutes Can now brush teeth with only slight bleeding of gums and no spontaneous bleeding Platelet count as shown on graphic chart for 9 days postoperative is as follows

	Day	Count
December 28, 1924	first	50 000
December 29 1924	second	80 000
December 30 1924	third	180 000
December 31 1924	fourth	150 000
January 1 1925	fifth	30 000
January 2 1925	sixth	15 000
January 3 1925	ninth	10 000
January 7 1925	eleventh	30 000
January 9 1925	thirteenth	60 000

Followed in clinic

April 21 1925 temperature 98.6 respiration 22 weight 135 He feels all right has no fatigue can work and play as well as ever There is no bleeding He has gained 5 4 pounds in 6 weeks and looks perfectly well

Hæmoglobin 80 per cent red blood cells 5 088 000

April 27 1925 blood platelets 10 000

Follow up—Six months after operation 444 patient feels perfectly well is active in athletics has no further hæmorrhages or petechiæ no bleeding on brushing his teeth The scar is firm

Twelve months after operation the boy is well The following month a few petechiæ appeared over the lower extremities Red blood cells 4 100 000 hæmoglobin 80 per cent blood platelets 5 000

CASE 79 C T age 47 H No 61775 May 1 1925 An Italian language teacher married was admitted December 20 1924 complaining of weakness for 3 weeks and black and blue spots for 2 months She had always been very well all her life except for some nosebleeds occasionally Two months ago she began to have large black and blue spots all over her body at first red then black and blue and then fading out She also noticed many small red spots on her legs Three weeks ago she started to have a nosebleed which persisted off and on and became much worse 4 days ago and was associated with slight dyspnea on exertion and weakness She gave no history of intestinal or gastric bleeding Temperature 99.8 pulse 100 respiration 24 blood pressure 110/70

Physical examination shows a well developed and nourished woman who appears quite ill. Variable sized ecchymoses are present all over her body numerous petechiæ The pupils are negative and react The abdomen obese the liver and spleen not felt no tenderness The extremities are negative

no edema is present The knee jerks are equal and active

Urine examination shows albumen 0 sugar 0 frequent white blood cells occasional red blood cell at times Wassermann negative Red blood cells 4 100 000 haemoglobin 95 per cent white blood cells 10 300 polynuclears 59 per cent leucocytes 24 large mononuclears 10 eosinophiles 6 Red blood cells show slight variation in size and shape White blood cells show occasional lymphocytes with coarsely granular cytoplasm Platelets practically absent Clotting time 9 minutes control 9 bleeding time 8 minutes control 5 minutes Stool is negative for blood Patient was observed on the medical service for 3 weeks and then transferred for

**Splenectomy** January 20 1925 The spleen was two to three times larger than normal Some adhesions were found along the lateral abdominal wall a thickened lienorenal ligament Pathological report Spleen uniformly enlarged with yellowish patches on capsule which microscopically prove to be old organized areas of purpuric hematoma Diagnosis purpura hemorrhagica

Patient did very well but had 2 severe nose bleeds one 15 days after operation the other 19 days after operation at which time the blood platelets were very low She was discharged February 16 1925 in good condition The platelets which were practically absent before operation gradually increased after operation reaching a maximum in 6 days and then falling off There was a leucocytosis following splenectomy The platelet count after operation is as follows

Day after operation	Platelets	Clumps
1st	25 000	No clumps
2nd	30 000	No clumps
3rd	45 000	1 2 clumps
4th	55 000	No clumps
5th	0 000	Few
6th	100 000	Several
7th	10 000	Few
8th	20 000	No clumps
10th	3 000	Practically absent

The white blood count after operation was as follows

Day	White blood cells	Polynuclears	Leucocytes	Large
1st	60 500	87	11	2
2nd	48 900	81	13	6
3rd	2 100	81	14	4
4th	2 000	7	20	3
6th	24 800	80	17	2
7th	26 700	85	10	5
8th	24 500	83	13	4
9th	92 400	86	10	4
10th	92 400	86	10	4
11th	2 600	80	14	2
12th	24 000	89	0	11

Bleeding time at operation was 8 minutes 6 days postoperative 1 minute 30 seconds 20 days 3 1/2 minutes

Clotting time at operation was 9 minutes 6 days postoperative 5 minutes 10 seconds 20 days 5 1/2 minutes

**Follow up** Two months after operation Result 4 3 4 Platelets 2 1/2 months postoperative 10 000 Bleeding time 2 1/2 months postoperative 18 minutes Clotting time 2 1/2 months postoperative 7 minutes

**Follow up** 6 months result 444 feeling very well No petechiae Blood platelets too few to count Red blood cells 4 500 000 haemoglobin 80 per cent Ten months follow up 444 no bleeding of any kind No petechiae Feels perfectly well Red blood cells 4 800 000 haemoglobin 83 per cent blood platelets 7 000 bleeding time 2 minutes

**CASE 80 A V History** No 62520 Readmission The patient is a 25 year old Italian housewife who was in the hospital for emergency treatment of a case of ulcerated strangulated hemorrhoids the early part of April 1925 She was discharged after 5 days completely cured of this condition the dilated thrombosed veins having been clamped and ligatured During the routine examination she was found to have a palpable spleen which was enlarged almost a hand's breadth below the left costal margin and as in her history there was made out a story of bruising easily and a prolonged bleeding time for small cuts and the like the splenomegaly was further investigated and the following laboratory findings were reported

Blood count Red blood cells 3 384 000 haemoglobin 53 per cent (Sahlb) white blood cells 10 900 polynuclears 74 per cent lymphocytes 26 per cent

Coagulation time 4 minutes control 3 1/2 minutes bleeding time 3 1/2 minutes control 1 1/2 minutes Blood platelets 15 000 in April 20 000 in May

She was followed in the out patient department by Doctors Hanford and Whipple and although she was having no symptoms from her purpura hemorrhagica (the diagnosis made on the above) she was advised to have her spleen out and is readmitted for this operation

Two days ago she coughed a little and has had a slight dry cough during the day since then

**Physical examination** Temperature 99.0 pulse 86 respiration 24 There has been no change since admission last month Her color is the same dark olive and her features are more those of a negress than of an Italian No petechiae or ecchymoses are present The eyeballs are prominent and pupils react the tongue is clean There is no bleeding from the gums The pharynx is negative the tonsils are not enlarged or inflamed The thyroid is not enlarged The lungs are resonant throughout no rales are heard The heart is not enlarged has regular sounds of good quality Blood pressure is 130-70 (left arm) The abdomen is soft and not tender no scars or hernia no tenderness The spleen is quite definitely enlarged about 7 to 8 centimeters below the left costal margin and extends a little anteriorly Pelvic examination not made There is no return of the hemorrhoids no anal tenderness

Diagnosis splenomegaly secondary anemia purpura hemorrhagica

Operation splenectomy for purpura hemorrhagica

**Pathology** The spleen was about double its normal size. It was exceedingly friable and there were dense adhesions to the left leaf of the diaphragm. The separation of these resulted at one point in a difficult point of hemostasis but hemorrhage was completely controlled. The pedicle of the spleen was about normal in size in its relation to the pancreas. The gall bladder and duct system appeared normal as did the liver and stomach. The splenic vessels were not sclerotic.

A left rectus incision was made. The spleen was drawn to the midline and forward its bed packed with roll of gauze adhesions separated from the diaphragm and bleeding point controlled. Vessel and pedicle were ligated separately. After removing the spleen inspection found hemostasis to be good. Gauze packing was removed and closure done as follows: Posterior rectus sheath and peritoneum with chromic stitch, backed anterior rectus sheath with continuous interrupted chromic subcutaneous tissue and skin with silk on pearl buttons. Skin with dermal.

Condition good Medication none Drains none Specimen spleen

**Follow up** After 3 months no recurrence of hemorrhage. Periods regular and normal. Gums still bleed slightly when brushed.

**CASE 81 L S** History No 62638 American housewife of 4 was admitted to hospital complaining of epistaxis and bleeding from gums beginning 4 weeks ago with a sudden profuse nosebleed lasting 24 hours. A second nosebleed a week later and 2 days before admission gums began to bleed profusely. She was sent in by the Dental Department for treatment of her general condition.

Patient's previous health has been good. She had a myomectomy and appendectomy 9 years ago and a complete hysterectomy 4 years ago.

Physical examination showed an obese white woman appearing chronically ill. Her skin was coffee colored and there were innumerable petechiae some as large as 3 and 6 millimeters in diameter scattered over her body. There were several bloody crusts on her lips. There were hemorrhagic areas on gums. The heart and lungs were negative. The spleen was palpable at the costal margin not tender. The left finger of the left hand had an unusually large purple area near the nail on admission.

**Laboratory findings** Blood count 3,000,000 red cells hemoglobin 50 per cent white blood cells 13,800 polynuclears 80 per cent. (On admission) Blood platelets were practically absent being counted as 4,000 and 2,000 on two occasions. Bleeding time, 8 minutes clotting time 6 minutes Blood Wassermann negative Blood oxygen capacity hemoglobin 50.4 per cent Stool showed guaiac 4 plus. There was slow retraction of the blood clot.

She was observed 1 week on the medical side running an irregular fever as high as 104.6 degrees. Herpes developed on lips but petechiae faded and only a few fresh ones were formed. She was given a direct transfusion 300 cubic centimeters of unaltered blood and transferred with the idea of doing a splenectomy.

On admission to the Surgical Ward she developed a cough and for the first 4 days bled persistently from the nose which was not controllable by fibrinogen or other method. The finger became very swollen and there was a marked subepithelial accumulation of blood. Her count fell to 1,050,000 hemoglobin 45 per cent. She was given an indirect transfusion—400 cubic centimeters of citrated blood and after this she stopped bleeding and for the past week has gradually improved with a clearing up of her cough and no further bleeding.

A week ago however she developed a tight otitis media which was followed by a left otitis media both drums being incised and the X-rays of mastoid cells on the right was suggestive of pathology. This has also done well. Her bleeding stopped her otitis cleared up and she was discharged with the understanding that she return later for a splenectomy if symptoms returned.

A letter written to the surgeon in another hospital who had operated on the patient 2 weeks later gives the following information: The patient was operated upon on May 26 1925 under ethylene anesthesia. The spleen was found to be about 2 1/2 times its normal size.

**Operation** Splenectomy. Patient's condition at close of operation not very good. Anemia very perceptible. Patient's condition about 1 hour after operation was apparently good. Pulse had slowed down to 100. She had regained consciousness and complained of pain. Within 1 hour her condition changed rapidly. She became pulseless respiration went down to 1 and she died within 30 minutes. No autopsy.

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Diagnosis splenomegaly secondary anemia  
purpura hemorrhagica

Operation splenectomy for purpura hemorrhagica

**Pathology** The spleen was about double its normal size. It was exceedingly friable and there were dense adhesions to the left leaf of the diaphragm. The separation of these resulted in one point in a difficult point of hemostasis but hemorrhage was completely controlled. The pedicle of the spleen was about normal in size in its relation to the pancreas. The gall bladder and duct system appeared normal as did the liver and stomach. The splenic vessels were not sclerotic.

A left rectus incision was made. The spleen was drawn to the midline and forward its bed picked with roll of gauze adhesions separated from the diaphragm and bleeding point controlled. Vessels and pedicle were ligated separately. After removing the spleen inpection found hemostasis to be good. Gauze packing was removed and closure done as follows. Posterior rectus sheath and peritoneum with chromic stitch locked. anterior rectus sheath with continuous interrupted chromic subcutaneous tissue and skin with silk on pearl buttons. skin with dermal.

Condition good Medication none Drains none Specimen spleen

**Follow up** After 3 months no recurrence of hemorrhage. Period regular and normal. Gums still bleed slightly when brushed.

**CASE 9.** L. S. History No 62638 American housewife of 42 was admitted to hospital complaining of epistaxis and bleeding from gums beginning 4 weeks ago with a sudden profuse nosebleed lasting 24 hours. a second nosebleed a week later and 2 days before admission gums began to bleed profusely. She was sent in by the Dental Department for treatment of her general condition.

Patient's previous health has been good. She had a myomectomy and appendectomy 9 years ago and a complete hysterectomy 4 years ago.

Physical examination showed an obese white woman appearing chronically ill. Her skin was coffee colored and there were innumerable petechiae some as large as 5 and 6 millimeters in diameter scattered over her body. There were several bloody crusts on her lips. There were hemorrhagic areas on gums. The heart and lungs were negative. The spleen was palpable at the costal margin not tender. The little finger of the left hand had an unusually large purple area near the nail on admission.

**Laboratory findings** Blood count 3 000 000 red cells haemoglobin 30 per cent white blood cells 13 800 polynuclears 80 per cent (On admission.) Blood platelets were practically absent being counted a 4 000 and 2 000 on two occasions. Bleeding time 8 minute clotting time 6 1/2 minutes Blood Wassermann negative Blood oxygen capacity haemoglobin 30.4 per cent Stool showed guaiac 4 plus. There was slow retraction of the blood clot.

She was observed 1 week on the medical side running an irregular fever as high as 101.6 degrees. Herpes developed on lips but petechiae faded and only a few fresh ones were formed. She was given a direct transfusion 300 cubic centimeters of unaltered blood and transferred with the idea of doing a splenectomy.

On admission to the Surgical Ward she developed a cough and for the first 4 days bled persistently from the nose which was not controllable by fibrinogen or other methods. The finger became very swollen and there was a marked subepithelial accumulation of blood. Her count fell to 1 050 000 haemoglobin 45 per cent. She was given an indirect transfusion—400 cubic centimeters of citrated blood and after this she stopped bleeding and for the past week has gradually improved with a clearing up of her cough and no further bleeding.

A week ago however she developed a right otitis media which was followed by a left otitis media, both drums being incised and the X rays of mastoid cell on the right was suggestive of pathology. This has also done well. Her bleeding stopped, her otitis cleared up and she was discharged with the understanding that she return later for a splenectomy if symptoms returned.

A letter written to the surgeon in another hospital who had operated on the patient 2 weeks later gives the following information. The patient was operated upon on May 26 1923 under ethylene anaesthesia. The spleen was found to be about 1 1/2 times its normal size.

Operation Splenectomy. Patient's condition at close of operation not very good. anemia very perceptible. Patient's condition about 1 hour after operation was apparently good. Pulse had slowed down to 100. She had regained consciousness and complained of pain. Within 1 hour her condition changed rapidly. She became pulseless respirations went down to 12 and she died within 30 minutes. No autopsy.

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in the former while in the latter it is either absent or evident only microscopically. In dependently one of us (Keith) suggested to Mussey the marked similarity of these two conditions. Mussey has reviewed the literature on the subject and has noted the close clinical similarity between a group of cases with pre eclamptic toxæmia and acute glomerulonephritis. This clinical similarity raises the possibility of a common etiology.

The term glomerulonephritis must be used with a clear definition of its meaning. It does not necessarily mean a lesion without tubular disease but rather a lesion that is primarily and chiefly limited to the glomeruli. Since the blood which reaches the tubules has first passed through the glomeruli it is obvious that any toxin will first affect the glomeruli but if it is of sufficient strength and acts for a sufficient length of time it will eventually involve the tubules as well and cause a diffuse nephritis. On the other hand according to Volhard the glomerular injury which can be demonstrated histologically is not proportional to the degree of toxæmia and in an early stage may not be demonstrable microscopically.

The most important symptoms of glomerulonephritis are hypertension, œdema and more or less hæmaturia. In mild cases œdema may be present without hypertension and yet there will still be lesions in the glomeruli. More frequently the hypertension will be present with little or no œdema. Hæmaturia may be so scant and of such short duration that its detection is difficult. Other symptoms of nephritis such as oliguria, albuminuria, cylindruria, dyspnoea, headaches, visual disturbances or convulsions may also be present.

Our twelve cases of acute glomerulonephritis were so classified because of the history of acute onset during pregnancy, the presence of hypertension and œdema and the other signs of acute glomerulonephritis just enumerated.

The average age of the patients was twenty-three. Nine were primiparas. Œdema was present while the patients were under our observation in ten cases and a history of earlier œdema was obtained in the other two. Of seventy-five blood pressure readings on

these patients the average reading for systolic pressure was 151 and for diastolic 104 millimeters. The fundi were examined in ten; in six they were normal while in four they showed pathological changes. Blood cells graded from 1 to 3 were found in the urine of five cases. The phenolsulphonaphthalein readings averaged 38 per cent, while the blood urea averaged 34 milligrams for each 100 cubic centimeters. Volhard's water test was made in three cases; it was normal in two but showed delayed excretion in the third. Five of the patients were delivered at the clinic, four children were normal and one was stillborn. The following cases are illustrative.

**CASE 1.** A primipara aged 27 came to the Mayo Clinic September 9, 1921, 8 months pregnant. Three months before her legs had begun to swell and 2 weeks before the swelling had extended to her face. Her home physician had been examining her urine regularly but found no albumin until 2 months before admission. There was marked œdema from the waist down and the face was puffy. The systolic blood pressure was 152 and the diastolic 110; both persisted at about this level. There was albumin 4 in the urine, casts 3 and erythrocytes 1. The blood urea was 62 milligrams for each 100 cubic centimeters. The patient was delivered of twins September 10 and following this her symptoms rapidly cleared. She returned to the clinic June 22, 1922, three months pregnant for several days observation. Her blood pressure was normal; there was no œdema and her urine never showed more than albumin 1; there were no casts or blood cells. Her urine was examined every 2 weeks until term when she was delivered of a normal child without further trouble.

**CASE 2.** A primipara aged 17 entered the Mayo Clinic September 22, 1921, in labor. She had noticed general œdema for about 1 month. The systolic blood pressure was 152, the diastolic 80 and the urine contained albumin 4 and a few casts. The blood urea was 26 milligrams for each 100 cubic centimeters. She was delivered of a normal child. About one half hour after delivery she had a slight convulsion and went into collapse which seemed to be of cardiac origin and about four hours after delivery after a number of short convulsions died. Necropsy showed marked diffuse nephritis, hypertrophy of the left ventricle and general obesity.

#### ACUTE NEPHROSIS

The term nephrosis has been used in a widely varying sense in the literature. Originally it was used by Mueller to denote degenerative as opposed to inflammatory changes in the kidney. Since this would in



A CLINICAL STUDY OF NEPHRITIS IN CASES OF PREGNANCY<sup>1</sup>

BY REED ROCKWOOD M D ROCHESTER MINNESOTA

Flow in Medicine Th M y F lat

ROBERT D MUSSEY M D ROCHESTER MINNESOTA

Sect on Obstetrics M y Clinic

AND

NORMAN M ALTH M D ROCHESTER MINNESOTA

Flow in Medicine M y Clinic

THE literature on the toxemia of pregnancy shows that the ideas of the obstetrician and the internist are frequently at variance. They do not use the same tests in searching for abnormalities of metabolism nor the same language in describing them. Frequently patients dismissed by the obstetrician appear later in the consulting rooms of the internist with definite nephritis and assert that it dates from the time of their last pregnancy. On the other hand a patient may assure the internist that she had a very severe toxemia during pregnancy although there is no sign of residual damage. In view of this it seemed desirable to report a series of cases which had been closely observed in the clinic either in the sections on medicine or obstetrics. In 1911 and 1912 100 consecutive cases of renal damage occurring during pregnancy were chosen for study. All patients were included who showed signs of hypertension, edema or renal injury during their present pregnancy and all those with renal damage which was supposed to date back to a former pregnancy. Forty three of this group who had pyelitis or pyelonephritis will not be discussed in detail here. Recently questionnaires have been sent to all patients concerning their present condition and the information thus obtained has been added to our records.

On the basis of the classification of Volhard and Fahr these cases have been grouped as follows:

A	Pyelitis and pyelonephritis	C 57
B	Hypertension and nephritis	3
I	Acute nephritis	57
	Acute glomerulonephritis	12
	Acute nephrosis	2
	Acute nephritis (unclassified)	1
II	Chronic nephritis	12
	Chronic glomerulonephritis	10
	Chronic focal nephritis	7
	Chronic nephritis (unclassified)	7

III	Sclerosis (vascular lesions)	9
	Benign hypertension	4
	Malignant hypertension	4

## ACUTE GLOMERULONEPHRITIS

Volhard has emphasized the resemblances between true eclampsia so called and the convulsive form of uræmia. He also cites pregnancy as one of the causes of acute glomerulonephritis. He says "but I see no possibility of differentiating clinically nephritis in pregnancy of unknown etiology from a specific nephritis in the non pregnant woman" and again "the histological picture is those unhealed or chronic cases which occur not infrequently correspondsends entirely to that seen in other cases of nephritis of chronic course with special involvement of the small renal vessels in the form of endarteritis obliterans."

Fahr has examined the kidneys in twenty eight cases of eclampsia and believes that the lesion is a degenerative one in the glomeruli a glomerulonephrosis. He also finds many hemorrhagic casts in the tubules which he thinks account for the hæmaturia. He says

"The most important and it appears to me the most constant change is found in the walls of the glomerular capillaries. The change consists primarily of a broadening and swelling of the capillary wall which occurs to different degrees of intensity. Many times it is only slight scarcely to be noted in other cases it is very marked somewhat agglutinated so that many loops are matted together in an almost homogeneous mass and the sharp cell outlines can no longer be recognized."

On the basis of his experience with nephritis among soldiers and the nephritis of pregnancy Heynemann also emphasizes the similarity in the clinical pictures. He believes that the main point of difference is the great tendency toward hæmaturia frequently macroscopic,

August 8 1918 During the interval she had been pregnant and had been delivered 24 months before The kidneys had caused further trouble during this pregnancy but its exact type was unknown The child was ill for some time after birth The patient when pregnant for the third time (7 months) came to the clinic because of general lassitude and swelling of the legs The urine contained albumin 3 and pus cells from 2 to 4 The systolic blood pressure was 150 and the diastolic 90 the excretion of phenolsulphonophthalein was 40 per cent The patient returned home and went through normal labor She returned again to the clinic November 22 1920 In the meantime she had been pregnant for a fourth time and except for moderate oedema of the feet was well until her labor in July 1920 About 40 hours after delivery she had had three convulsions and following this felt fairly well Her physician told her however that there was considerable albumin in the urine and that her blood pressure was high On admission the systolic blood pressure was 195 and the diastolic 135 the excretion of phenol sulphophthalein was reduced to 20 per cent while the urine contained albumin 4 blood cells 1 and pus from 2 to 3 but no casts The blood urea ranged from 88 to 128 milligrams for each 100 cubic centimeters The culture of the urine showed staphylococcus and bacillus coli but a second cystoscopic examination did not reveal a local lesion

Renal function became progressively worse the blood urea ranging from 344 to 422 milligrams for each 100 cubic centimeters and the blood creatinin from 20 to 23 milligrams for each 100 cubic centimeters The pyuria persisted changes were observed in the fundus and secondary anemia appeared The patient died July 4 1922 Necropsy revealed advanced chronic glomerulonephritis and bilateral hydronephrosis ascites bilateral hydrothorax anasarca oedema of the intestinal wall massive oedema of the lungs with early bronchopneumonia subacute fibrinous pericarditis and moderate myocardial hypertrophy and dilatation

This case is somewhat atypical in two respects first the added presence of pyuria and infection with bacillus coli and second the presence of an infection at the onset of pregnancy The more usual course is the persistence of the acute glomerular type without improvement and with gradual impairment of renal function The distinction between ordinary nephritis and pyelitis or pyelonephritis is usually quite sharp but sometimes as in this case certain elements of each are combined

#### CHRONIC FOCAL NEPHRITIS

According to Volhard focal nephritis is caused by pathological changes in the kidney

which are not sufficient to encroach on the margin of safety and lower renal function and which are clinically unaccompanied by such general symptoms as hypertension or oedema

No cases of acute focal nephritis were noted in this series Such cases would present albumin casts and perhaps blood cells in the urine without general symptoms or signs of more extensive renal damage or disturbance of renal function

Ten cases were called chronic focal nephritis because only the urinary findings of nephritis were present renal function being normal and hypertension or cardiac hypertrophy and oedema being absent

However in eight of these ten cases there was a history of oedema during the onset in pregnancy and although no definite history of hypertension could be obtained it is probable that these cases were originally of the same group as the acute glomerulonephritic type but had recovered to such an extent that only a focal residue persisted Examination of the fundus was negative in six of these patients while in one there were signs of old retinitis

CASE 6 A woman aged 26 came to the clinic September 30 1920 complaining of backache and dysmenorrhoea Four years before during her first pregnancy she had suffered from general oedema with albuminuria and had given birth to a dead child Three years before admission during her second pregnancy this trouble recurred but the child was normal Since that time the ankles had swollen a little in the afternoons On the whole her health had been good The urine contained albumin from 2 to 3 and an occasional pus cell and blood cell The blood pressure fundi and renal function were normal A year later she returned again to the clinic on account of dysmenorrhoea and her renal condition was apparently unchanged

#### CHRONIC NEPHRITIS (UNCLASSIFIED)

Seven cases were placed in this group largely because the patients were not available for a long enough study to make an exact classification possible Hence this group does not argue against the accuracy of Volhard's grouping The average systolic blood pressure in these cases was 174 and the average diastolic 115 The phenolsulphonophthalein tests averaged 31 per cent in twelve readings and the blood urea 4 milligrams for

clude arteriosclerotic changes as well. Volhard further limited its use to primary degenerative changes. Typical examples usually given are the kidney seen in poisoning by bichloride of mercury and the amyloid kidney. By other authors the term is considered to mean a lesion limited to the tubules in contradistinction to one confined to the glomeruli. Others apply the term to a clinical syndrome characterized by massive edema without hypertension and the urinary changes of nephritis but with relatively good renal function except for excretion of water and salts. Still others emphasize the low protein and high lipid content which occurs in the serum in similar cases. Since part of these criteria are pathological and part clinical it is obvious that no exact classification can be made until a larger series of cases has been studied from both standpoints.

We have used the term nephrosis to describe cases occurring in pregnancy in which although considerable edema and the urinary findings of nephritis were found the blood pressure was normal and little disturbance of renal function was evident except for the excretion of salts and water. Heynemann has observed cases of massive edema without significant urinary findings in soldiers at the time nephritis was prevalent. He believes that the famous type of edema can be excluded in these cases since the patients were well fed and well nourished men. Two cases of this type are described.

**CASE 3.** A primipara aged 21 came to the Mayo Clinic in labor April 1, 1921. Edema was marked up to the knees and the urine contained albumin 3 but no casts or blood cells while the blood pressure and blood urea were normal. She was delivered of a healthy child. Since that time she has had three deliveries at the clinic without any recurrence of the renal symptoms.

**CASE 4.** A primipara aged 21 came to the clinic December 29, 1921. The last menstruation occurred April 9, 1921. About two weeks before admission she had had quite a severe attack of diarrhea lasting about 5 weeks. About a month before admission she had noticed intermittent edema of the legs and face. For the previous days it had been persistent and she had become quite dyspnoeic. Her home physician had found albumin in the urine. Examination on admission showed edema of the legs, albumin of the face, normal blood pressure and albumin 4 in the urine. There were no casts or blood cells in the

urine and the blood urea was normal. The patient was delivered of a normal child January 2, 1922. By this time the edema had practically disappeared. She returned to the clinic 4 months later for the extraction of teeth. On examination only albumin 1 was found in the urine while the blood pressure was still normal. There was no further edema.

#### ACUTE NEPHRITIS (UNCLASSIFIED)

One patient was seen with acute nephritis of pregnancy superimposed on an old pyelonephritis associated with bilateral choked disk. The lesion could not be satisfactorily placed in any group.

#### CHRONIC GLOMERULONEPHRITIS

Twelve cases were placed in this group. There was a history of acute onset with edema during pregnancy and at the time of admission to the clinic at varying intervals after the pregnancy. Chronic nephritis with hypertension was manifested, either with a tendency to lowered renal function. Edema was not necessarily present at the time of the admission.

The average age of the patients was thirty-four. The average blood pressure readings in this group were 189 systolic and 116 diastolic. The fundi were normal in three cases while in nine there were signs of retinitis or vascular change. Blood cells were seen in the urine at the time of examination in six cases. The average of twenty-three tests with phenolsulphonephthalein was 33 per cent. The average of twenty-four blood urea tests in eleven cases was 119 milligrams for each 100 cubic centimeters. Water tests were made in five cases and were normal in two while in three the excretion of water was delayed. In three cases the urine could not be concentrated well while in two the power of concentration was normal.

**CASE 5.** A woman aged 25 first came to the Mayo Clinic December 18, 1916. In January 1917, when 4 months pregnant, the patient had influenza and threatened miscarriage. Her doctor found albumin in the urine at that time. Delivery was normal but she felt generally miserable and had a great deal of abdominal pain. The child died from convulsion in 3 weeks. At the time of her admission the blood pressure and renal function were normal but albumin 2 and pus 3 were found in the urine and culture of the urine for bacilli coli was positive. Cystoscopy was negative. She returned to the clinic

In the four cases which we have placed in this group one was malignant in the sense of Volhard while three were of the type described by Wagener and Keith.

Predisposing factors in these cases were convulsive toxæmia of pregnancy typhoid fever and a dead fetus in the uterus. In two there was slight oedema of cardiac origin. The average systolic blood pressure was 201 and the diastolic 127 of twenty seven readings. Pathological changes were found in the fundi in three cases the fourth was not examined. The renal function was good in three cases and poor in the fourth.

**CASE 8 (Renal type of malignant hypertension)**  
A woman aged 46 entered the clinic May 5 1921 because of oedema and dyspnoea. Eighteen years before during her first pregnancy she had suffered from toxæmia with seven convulsions and her physician had found albumin and casts in her urine most of the time since. She had also had much trouble with severe headaches nausea and vomiting. There were two more uneventful pregnancies following the first and she got along fairly well until the spring of 1919 when she had influenza and broncho pneumonia. Following this a certain amount of dyspnoea and slight oedema appeared. In January 1921 she suffered from severe vomiting attacks followed by marked dyspnoea and orthopnoea together with occasional attacks of precordial pain. On admission she was very dyspnoic and showed considerable cyanosis marked anasarca ascites and pulmonary congestion. The heart extended to the axilla and the blood pressure throughout remained about 240 systolic and 110 diastolic. The fundi showed marked arterial changes with numerous exudates and a few small hamorrhages. The urine contained albumin 1 but no casts and only an occasional erythrocyte. The phenolsulphonephthalein test showed no excretion of the dye while the blood urea varied from 130 to 170 milligrams for each 100 cubic centimeters and the blood creatinin from 8.6 to 8.8 milligrams. There was a rather marked secondary anemia. Hemoglobin was 55 per cent and the erythrocytes numbered 740 000. The oedema and dyspnoea almost entirely disappeared with a karell diet digitalis and diuretin. The patient returned home but later the dyspnoea and oedema returned and she died about two and one half months afterward.

The differential diagnosis in this case of long standing glomerulonephritis following toxemia and chronic hypertension with terminal nephritis is difficult to make here in the absence of postmortem examination. We have tentatively placed it in the group of malignant hypertension because of the long period of

freedom from serious trouble with the development of marked hypertension and re-  
tinitis with poor renal function and the pre-  
dominantly cardiac nature of her terminal  
dyspnoea and anasarca

CASE 9 (Diffuse vascular type of malignant hypertension) A woman aged 38 came to the clinic July 4, 1921 because of the high blood pressure. She had seven children living and well. With each of her pregnancies there had been remission of the legs but no other symptoms. In the summer of 1921 a dead fetus was retained for 4 months and was delivered naturally at the eighth month. Since that time she had never regained her usual strength. She had been subject to migraine all her life but after her last delivery the symptoms became more severe and almost continuous. In the late spring of 1922 she consulted an ophthalmologist for failing vision which had been coming on for 5 or 6 years. He told her she was suffering from retinitis and sent her to a physician who found the blood pressure increased. Since then the systolic pressure has varied between 180 and 90 in spite of the use of nitrates and iodides. On her admission the heart was moderately hypertrophied and the peripheral arteries thickened while the vascular changes of hypertension with a few hemorrhages and one exudate were evident in the fundi. The systolic blood pressure on admission was 240 and the diastolic 120. With rest and nitrates they were reduced to 150 and 90. The blood urea, the phenol sulphonphthalein, the water and concentration tests were negative. There was pu. 1 in the urine and the culture of the urine for bacillus coli was positive. Two and one half years later she reports fair health.

#### TIME OF ONSET OF NEPHRITIS IN PREGNANCY

Other points of interest have been raised in the literature on which our statistics have some bearing. Prumparas are supposed to be particularly predisposed to the nephropathy of pregnancy. Our statistics show the number of pregnancies as follows: I para 32, II para 7, III para 5, IV para 4, V para 2, VI VIII  $\lambda$  and  $\lambda\lambda$  para one each and none for VII and IX para.

In two cases the disease antedated pregnancy but was aggravated by it. In this connection the numerical preponderance of primiparas over multiparas must also be taken into consideration.

The time in relation to pregnancy when the onset of symptoms appeared is given in cases in which it could be ascertained before pregnancy 2 cases first month none second month 3 third month none fourth month, 4 fifth

each 100 cubic centimeters of blood in seven readings. The fundi were negative in three cases and showed positive findings in three. In two cases there was a history of edema. The average age of these patients was forty.

#### BENIGN HYPERTENSION

Adair Mussey and Randall and others have emphasized the importance of hypertension as an index of the toxemia of pregnancy. The exact cause of hypertension is unknown. Allbutt, Volhard and others have emphasized the importance of so called benign or essential hypertension in which the blood pressure may be high for many years without disturbance of cardiac and renal function. The hypertension of pregnancy differs from the type ordinarily seen in that it has a more acute onset and tends to disappear, in most cases following delivery. In a certain percentage of cases however it persists after delivery and the patient may later come to the internist with typical persistent essential hypertension. These are the cases included in this group and an illustrative one is described.

In considering the significance of the hypertension of pregnancy several points must be borne in mind. Volhard has shown that hypertension without edema is seen in a considerable percentage of the cases of acute glomerulonephritis and also that the hypertension may come on very rapidly in the course of a few hours in certain cases. This is one of the reasons he gives for postulating a vascular spasm of the arterioles as an important cause of acute glomerulonephritis. Keith and Thomson have shown in their studies of nephritis in soldiers that in many cases a good renal function was maintained. Thus acute glomerulonephritis without edema and with good renal function would approximate clinically the hypertensive toxemia of pregnancy and the return of the hypertension to normal after delivery might be compared to the similar fall observed in cases of the nephritis of soldiers. Therefore it is not impossible that the hypertension observed in pregnancy including that which ceases as well as that which persists after delivery may be only the early stage of the vascular lesion which pro-

ceeding further can be associated with marked edema and other symptoms of nephritis.

The average age of these nine patients was 32 years. Four were primiparas. Influenza and the intra uterine presence of a dead fetus appeared to be predisposing causes in one case while in four cases there was a definite history of convulsive attacks in pregnancy. In two cases slight edema of cardiac origin was present. In twenty three readings the average systolic blood pressure was 188 and the diastolic 117. The examination of the fundus was negative in five cases but in three cases was of a character suggestive of old neuroretinitis was found. The renal function was good in all cases.

**CASE 7.** A woman aged 26 first came to the Mayo clinic July 14, 1922 because of headaches and dizziness. In February 1920 abortion had been performed because of placenta praevia. In November 1921 during her second pregnancy she began to suffer from severe morning headaches with vomiting. Her home physician found the blood pressure following her first attack of vomiting in February 1922 to be 165. The urine contained only a slight trace of albumin at times and no blood. There were no chill, fever or edema. Abortion was performed in March. Following this the blood pressure decreased to 140 and she felt better until July when it mounted to 190 and was accompanied by a recurrence of the headaches and dizziness. During two weeks in the hospital under our observation her blood remained at a systolic pressure of about 190 and a diastolic of 130. The highest systolic was 225 and the highest diastolic 150. The renal function was normal and the urine never contained more than albumin 1. There was slight reduction in the caliber of the retinal arteries while direct capillaroscopy showed that the capillaries were of the arteriosclerotic type and that their function was slightly disturbed. When last heard from in December 1924 she was again 3½ months pregnant the systolic blood pressure was 170 and the urine normal.

#### MALIGNANT HYPERTENSION

The term malignant hypertension is employed in the literature in two senses. Volhard and others use it to mean a benign hypertension in which the vascular lesion has progressed to involve the vessels of the kidney and thus cause secondary nephritis while Wagener and Keith use it to apply to a group of cases in which the renal function is good but vascular and retinal changes are very severe and diffuse with death as a result of the general vascular lesion.

larly true of the group of chronic glomerulonephritis

TABLE III—END RESULTS OF NEPHRITIS OF PREGNANCY

Diagnosis	Number Cases reported	Result			
		Good	Un- known	Bad	Total
Acute glomerulonephritis	12	8	4	2	14
Acute nephritis	2	2	1	1	4
Acute nephritis (unclassified)	1	1	1		2
Chronic focal nephritis	10	4	3	1	8
Chronic glomerulonephritis	12	12	5	2	19
Benign hypertension	9	7	2	2	11
Malignant hypertension	4	3	1	1	5
Chronic nephritis (unclassified)	7	4	1	1	6
Total	57	41	12	7	60

### DISCUSSION

We have shown that the nephropathy of pregnancy and its sequelæ can be classified clinically into the same groups as that of the ordinary type of nephritis. We have disregarded so called true eclampsia in which at necropsy pathological change is found only in the liver if at all. Harris has recently reviewed 177 cases of toxæmia of pregnancy from the Johns Hopkins Hospital. Fourteen of the patients died and of the remainder 111 returned for further study at the end of one year. The condition was classified into three groups: eclamptic toxæmia, pre-eclamptic toxæmia, and nephritic toxæmia. Of twenty-seven patients with eclampsia seen a year later three had chronic nephritis. Of 55 patients with pre-eclamptic toxæmia 60 per cent suffered from chronic nephritis the following year and all of the 30 patients whose cases were diagnosed as nephritic toxæmia now suffer from chronic nephritis. The larger percentage of residual chronic nephritis in all three groups suggests that the classification is more or less of an arbitrary one and that the fundamental process in all groups is similar.

The more modern tendency seems to be to consider nephritis as a systemic disease rather than as one limited exclusively to the kidneys. No plausible explanation of the symptoms of oedema and hypertension has been advanced when only pathological changes in the kidney have been considered but when extensive lesions of the smaller blood vessels (capillaries

or general body tissues are postulated these phenomena become much more understandable.

The vascular changes can be demonstrated clinically in the small vessels of the eye and by direct capillaroscopy in the nail fold. Brown and Roth have called attention to a possible toxic lesion of the bone marrow that causes anaemia. Dunn and McNee have shown similar lesions about the vessels of the brain and spleen. With such a widespread vascular involvement it is no wonder that the small vessels and capillary tufts of the glomeruli are seriously damaged and it is in the kidney especially that such damage has disastrous effects on renal function. Similar vascular injury in the liver would pass unnoticed because of the wide margin of safety which must be overcome before symptoms of hepatic insufficiency are manifest and because of its marked power of regeneration. Perhaps some of the more modern tests of hepatic function will reveal evidence of hepatic damage in nephritis.

A similar state of affairs apparently exists in the toxæmias of pregnancy. Hinselmann has recently shown that in eclampsia capillaroscopy reveals capillary changes which gradually return to normal in the course of several months but that if chronic nephritis develops these changes are more marked and permanent. These observations were later confirmed by Nevermann, Baer and Reis, Linzenmeier and Hinselmann, Nettekoven and Silberbach. The last mentioned authors found changes in capillary circulation in 80 per cent of twenty-five cases of eclampsia; they consisted of structural changes and alteration of flow. Baer found normal capillaries in normal pregnancies. The presence of oedema, hypertension and abnormalities in the eye grounds, as well as renal changes, illustrates the diffuse nature of the process. Cheney has recently reviewed the literature and discussed the incidence of retinitis in the toxæmias of pregnancy.

If we assume the existence of a diffuse toxin that attacks the vascular system which in nephritis seems to be often bacterial in origin we can postulate different degrees of damage, depending on the potency of the

month 2, sixth month 3, seventh month, 7 eighth month 7, ninth month one and post partum, one

### FOCAL INFECTION

Focal infection is often discussed in connection with nephritis of all kinds. Table I shows results of the examination of 54 of the 100 cases in this series. The cases of pyelonephritis thus share in the figures of focal infection. Since there was no significant difference between the two groups of nephritis we have put them together. We have also tabulated from the history previous infections which might have been partly responsible for the renal damage. Facts in this connection were available in 87 cases. As a control group we secured the same data on the same number of normal pregnant women who were delivered at the Mayo Clinic during the same period as our original group.

TABLE I — NEPHRITIS

	P	t	C
Previous infections			
Diphtheria	6	8	
Scarlet fever	22	17	
Pneumonia	19	16	
Typhoid fever	0	4	
Influenza	38	47	
Tonsillitis	42	44	
Rheumatic fever	7	5	
Leucis	6	6	
Malaria	3	0	
Focal infections by patients			
Dental sepsis	25	27	
Tonsillar sepsis	0	2	
Bith dental and tonsillar sepsis	7	16	
Sinusitis	1	1	
No focus	15	2	

Focal infections were slightly more common in the control group but it must be remembered that it is the type of organism rather than the type of focus which is apparently of most importance. In spite of considerable discussion in the literature of the possibility of the nephritic symptoms of the toxæmias of pregnancy being exacerbations of pre-existing chronic nephritis we were unable to get a history suggestive of preceding nephritis in more than two

cases covers several pregnancies we have taken the results of all pregnancies in all mothers. This method tends to minimize somewhat the mortality directly due to the renal lesion.

TABLE II — FATE OF CHILDREN

Diagnosis	P	t	C	M	S	U	W	P
Acute glomerulonephritis	12	15	2	3				75
Acute nephrosis and acute nephritis (unclassified)	3	5						100
Chronic focal nephritis	10	20	2	2				15
Chronic glomerulonephritis	12	16	1	1				10
Benign hypertension	9	8	6	1				4
Malignant hypertension	4	13	4	1				78
Chronic nephritis (unclassified)	7	17	5	3				64
Total	5	103	28	14	4	1		60
Average								

### THE END RESULTS OF NEPHRITIS OF PREGNANCY

The end results of our series from  $\frac{1}{2}$  to  $3\frac{1}{2}$  years after admission are shown in Table III. Forty of the fifty-six patients were traced. The state of health which is given as a basis of classification is based on the patients' general statements as well as on the more specific data furnished in the questionnaires on blood pressure, urinalyses and so forth. Some of the patients were re-examined at the clinic.

Since advice against further pregnancy was given in most cases, few further pregnancies are reported. One patient had two miscarriages, one had three normal children and four others had normal pregnancies.

The end results show that the mortality is high, approximately 25 per cent. The point of greatest interest is the prognostic significance which is revealed when the cases are grouped according to the Volhard classification at the time of examination. In cases diagnosed as focal nephritis, benign hypertension and nephrosis, the patients recovered for the most part with little residual disease. The groups called chronic glomerulonephritis, malignant hypertension and chronic nephritis (unclassified) show a high mortality. This is particu-

### FATE OF THE CHILD

The fate of the child in these cases is of interest (Table II). Since the history in some

## VOLVULUS OF THE CÆCUM

## REPORT OF A CASE COMPLICATING TYPHOID

BY HENRY FLACK GRAHAM M.D. F.A.C.S. BROOKLYN New York

**V**OLVULUS of the cæcum is of sufficient rarity to justify the publication of all undoubted cases. The developmental anomaly that causes it together with its dramatic onset and unusual interest at the time of operation all join in placing it a little out of the common run of surgical work.

In 1898 von Manteuffel collected 4 cases in 190 Faltin increased this number to 79 and in 1913 the number was raised by Bundschuh to 110. Bundschuh did not include five of Faltin's cases since they were associated with incarcerated hernia or invagination. A few others were not included among them cases published by Corner and Sargent. A number of cases have been reported since 1913 those by Beeger, Jacobsen, Homans and Ohman being among the more recent.

It is generally conceded that a mobile cæcum is necessary to the production of volvulus. This anomaly of development is described by Gray as follows:

After the third month of fetal life the lower arm of the umbilical loop which becomes the cæcum and colon begins to pass over the upper arm which later becomes the duodenum and small intestine.

The cæcum which has already developed an appendix thus comes to lie up under the liver. The cæcum increases in length and finding least resistance below finally settles in the right iliac fossa dragging down a short ascending colon. The mesentery of the cæcum and ascending colon usually disappears and fusion of the posterior wall of the colon to the posterior abdominal wall takes place. Occasionally however the cæcum and ascending colon retain a more or less distinct mesentery.

In speaking of volvulus Moynihan says: The sigmoid flexure is most commonly affected but the ileum, jejunum or cæcum may also be separately or conjointly involved.

In the majority of cases some anatomical abnormality is the determining factor—such as the cæcum and ascending colon suspended

by a mesentery continuous with the mesentery of the small intestine.

Von Thun states that in the infant, mobile cæcum is sometimes due to a retardation in development in elderly persons to a general feebleness of the organs, and in the adult to a sort of arrest of development or as mentioned by Rovsing to general enteroptosis.

In addition to the anatomical abnormality mentioned by most authors Corner and Sargent discuss in some detail what they call an acquired volvulus. This they consider to be present in rotation of the cæcum on its long axis. The cæcum in fetal form is tapered. It takes on at times however a pouch-like form and this form when distended or subject to contraction of the abdominal muscles is very liable to twist.

Other predisposing causes are:

- 1 Old scar formation and chronic mesenteritis (Philpownicz, Kuettner, Robinson)
- 2 Former operation (Whiting, Riedel, Huebner, Schultze, Robinson, Shepard)
- 3 Hernia (Rokitansky, Vaughan)
- 4 Fibrous bands (Tesson)
- 5 Mesenteric cysts (Huebner, Fertig)
- 6 Habitual constipation and chronic intestinal stasis with traction on mesentery (Bosquette, Delore)

Faltin who found a higher proportion of cases in Finland and Russia believed the dietary customs of these two countries to be a predisposing factor. The vegetable diet of the Russians together with the great number of fast days (120) bring about dilatation and atony while in Finland the diet consisting mostly of potatoes and sour bread is in the same category.

The rotation of the intestine is of three types:

- I Circular rotation with one fixed point. The mesentery is common to the whole of the small intestine, the cæcum and part of the colon. The root of the mesentery is thus much smaller and less widely spread. The axis may



toxin and its localization. Acute glomerulonephritis may occur with or without edema (r8). It would be possible to have marked damage of capillaries or tissues with edema and no hypertension and good general renal function (nephrosis). If the lesion extended from the glomeruli to the tubules it would take the form of the combined glomerulonephritic and nephrotic form of Volhard. If the lesion healed with little remaining damage the disease would then be chronic focal nephritis with good renal function. If the brunt of the attack was borne by the vessels rather than by the finer capillaries and the kidney the result would be residual benign hypertension. If the vascular involvement slowly progresses to involve the finer vessels of the kidney malignant hypertension in the sense of Volhard would be the consequence and if the vascular degeneration was extreme and slowly progressive it would take the form of malignant hypertension described by Wegener and Keith with adequate renal function.

A similar course of events might be postulated in pregnancy. The source and nature of the toxin are entirely unknown although many explanations have been advanced. If the toxin acts chiefly on the liver it would cause that type of eclampsia which is associated with hepatic degeneration. Commonly it is more diffuse and widespread in its action and a series of clinical pictures is produced which is very similar to those seen in nephritis.

#### SUMMARY

Many of the toxemias of pregnancy are associated with nephritis and can be classified as are other types of nephritis, not necessarily occurring in pregnancy. The classification of Volhard and Fahr is followed.

The course of fifty seven cases during pregnancy is followed together with the fate of the mother and child over a period of 3 years.

Both nephritis and toxæmia of pregnancy seem to be general diseases affecting the cardiovascular system as a whole.

When the toxæmia of pregnancy is classified by the same method which Volhard uses for nephritis a marked difference in the end

results is seen and this difference allows the physician to make a more accurate prognosis both as to the mortality among the mothers and as to the fate of the child in subsequent pregnancies.

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On January 9 9 days after admission and during the third week of his illness he complained of a severe pain in the right lower quadrant of the abdomen. His temperature which had steadily remained above 102 degrees immediately dropped to 97 degrees and the pulse dropped from 100 to 80 per minute.

Before the onset of pain there was only slight abdominal distention but within 12 hours this became quite marked. A blood count now showed 100 white cells and 80 per cent polynuclears. He was covered with a cold clammy sweat and the pulse became small and thready. The pain was intermittent in character. When present it was very intense but relief was almost complete in the intervals between paroxysms.

A surgical consultation was now requested. When seen at 2 p.m. this patient did not impress one as being acutely and dangerously ill. His face was placid and the pain had temporarily ceased. The abdomen was moderately distended but was not tender or rigid anywhere. In fact the abdominal wall seemed flaccid. An indefinite resistance was felt across the lower abdomen giving the impression of cord like loops of intestine. The picture was not that of a perforation. The pain was that of an obstruction but why should an obstruction occur in the third week of typhoid?

It was considered advisable to wait a few hours longer but a second blood count showed 600 white cells and a polynuclear rise to 93 per cent. A provisional diagnosis of a walled-off perforation with obstruction was made. Operation was done by the author and was carried out entirely under local anesthesia—0.5 per cent novocain being used.

Through a 6 inch incision from umbilicus to symphysis an examination was made. An enormous coil of dilated large bowel was found filling the pelvis. The size was that of an ordinary muskmelon. After considerable study it was shown to be a huge cecum which was entirely loose and free from attachment to the posterior abdominal wall well up to the hepatic angle. This had rotated a half turn causing the ileum to pass anteriorly and come to lie on the outer side of the cecum and enter it from the right instead of from the left. Rotation clockwise looking vertically downward from head to foot. The volvulus was untwisted. A needle was passed through the base of the appendix into the cecum and by means of a suction pump the air which was causing the great distention was removed. A purse string was inserted the infected appendix removed and the stump buried.

To prevent a recurrence of the volvulus the anterior longitudinal band was sutured to the anterior abdominal wall. No perforation was present. The suturing was done in layers and no drainage used.

On the day following operation the patient seemed improved. His bowels moved well and a large amount of flatus was expelled. In the afternoon he had a chill and the temperature rose to 105 degrees.

pulse to 130 and respirations to 50. There was slight dullness in the lower left chest posteriorly with fine crackling râles. Moist râles were present in the axilla and anteriorly. Heart sounds were poor—hardly perceptible. The bowels moved in response to enemata. Flatus was passed. There was occasional vomiting.

On the second day following operation the entire chest was full of moist râles the pulse became imperceptible and the patient died. In my opinion this patient died of pneumonia. Please note however that it was not an ether or gas pneumonia because no general anesthetic was used. A post mortem examination was refused.

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The importance of the veins is illustrated by the 'caput medusæ' of portal obstruction. It is abundantly drained by lymphatics and although the direction of drainage is mostly from it there is little doubt but that in pathological conditions these become obstructed and the flow reversed in the same manner as is that of the veins. Pathologically the lymphatics are of importance in the occurrence of metastatic carcinoma at this site and also in accounting for the discoloration of the umbilicus in intraperitoneal hæmorrhage.

In 1916 Cullen collected from the literature 97 cases of carcinoma of the umbilicus. Of the 25 primary growths 3 were squamous cell epitheliomata and 22 adenocarcinomata having their origin in remnants of the omphalomesenteric duct. Of the secondary group in 27 instances the original growth was in the stomach in 5 in the gall bladder in 5 in the intestine in 10 in the ovary and in 4 in the uterus. In 21 instances the site of the primary tumor was not determined.

Since the publication of Cullen's book 3 cases have been reported: 1 case by Wohl of cancer of the umbilicus secondary to cancer of the transverse colon and 2 cases by Warner in one of which the original growth was in the stomach and in the other in the rectum. Counting the author's case the figures at present are as follows:

Primary squamous cell epitheliomata	3
Primary adenocarcinomata	22
Secondary to cancer of the stomach	28
Secondary to cancer of the gall bladder	5
Secondary to cancer of the intestines	8
Secondary to cancer of the ovary	10
Secondary to cancer of the uterus	4
Site of primary growth not determined	21
	<hr/> 101

In the cases secondary to cancer of the bowel the site of the primary lesion was as follows:

Rectum	3
Transverse colon	3
Cæcum	1
Nearly all of large intestine	1
	<hr/> 8

The manner in which the malignant cells reach the umbilicus is of considerable interest. Usually it is by way of the lymphatics but in 5 cases secondary to carcinoma of the

stomach and in 1 case secondary to carcinoma of the transverse colon the primary growth had become adherent to the peritoneal surface of the navel and had ulcerated through with the formation of a gastro-umbilical or colo-umbilical fistula. In several instances the tumor originated from a secondary nodule in the omentum which had become adherent in the sac of an umbilical hernia.

The usual route of extension is however via the lymphatics. These are divided into three sets: the superficial running in the subcutaneous fat to the axillary and inguinal glands; the preperitoneal running in the preperitoneal tissue to the deep inguinal glands; and the peritoneal draining also into the deep inguinal glands and upward through the diaphragm into the parasternal chains. There is a separate channel running along the round ligament of the liver.

Were the normal lymphatic stream toward rather than away from the navel umbilical carcinoma secondary to carcinoma of the viscera would doubtless be more common. As it is it is probable that for cells to arrive there the normal stream must be obstructed and the flow reversed. This is doubtless the reason that it is most often secondary to cancer of the stomach and ovary malignancies which metastasize early and extensively to the peritoneum and in the case of the former to the liver. In carcinoma of the stomach and intestines metastasis is usually by way of the round ligament and is secondary to nodules in the liver. In cancer of the gall bladder extension by the same route is obvious. Some writers suggest that metastasis may even be retrograde from the inguinal glands. In pelvic conditions this is not beyond the possible.

#### PATHOLOGY

The umbilical growths may vary in size from small subepithelial or epithelial nodules to large ulcerated tumors. The smallest growth observed was but a few millimeters in diameter while the largest was the size of a child's head. The size and degree of ulceration depend of course upon the duration.

When the involvement is by direct extension from the stomach or intestine the

# CANCLR OF THE UMBILICUS SECONDARY TO CANCER OF THE CÆCUM

By JEROM L. R. HAFAD M.D. MADISON WISCONSIN  
From the S. E. 15 room, I. C. A. H. (b) in Stat. (Wisc. ns. G. ral Hosp. tal)

THE present case of metastatic malignancy of the umbilicus secondary to adenocarcinoma of the cæcum is reported because it is an instance of a rare condition and also because it serves to emphasize the importance of the navel as a mirror of the intraperitoneal pathological condition.

Cancer of the cæcum with metastases to the peritoneum umbilicus and skin S. W. G. H. S. No. 1649. Mrs. R., a Norwegian American housewife of 63 years, entered the hospital February 19, 1923, complaining of abdominal pain, vomiting and constipation.

The family and past histories were essentially negative with the exception of the fact that for many years she had been troubled with epigastric distress and gaseous and sour eructations coming on shortly after meals.

She dated her present illness from 3 years before entrance at which time she began to have pain across the lower abdomen. Two weeks after the onset of the pain she called her physician who made a diagnosis of acute appendicitis and advised immediate operation. Exploration revealed a distended small bowel and an inoperable tumor of the cæcum. Since that date she had been gradually losing weight and strength and becoming more and more constipated. The pain in the right lower quadrant had persisted and grown worse.

About a year after the onset of her trouble she noticed a small pimple at the umbilicus which bled when it was scratched. It continued to increase in size and at entrance was a raised ulcerated fungating growth 6 centimeters in diameter.

Two days before entrance to the Wisconsin General Hospital she was taken with a severe cramp-like pain in the lower abdomen. She vomited several times during that day and the next and only by repeated enemata was she able to accomplish any movement of her bowels. The day of entrance she became decidedly worse vomiting and wrenching every few minutes. On entrance to the hospital the vomiting had stopped and she felt much better. The vomitus had never been fecal.

Physical examination showed evidence of considerable recent loss of weight. The liver was easily palpable. In the right lower quadrant of the abdomen was a hard irregular tumor about 15 by 7 centimeters which seemed to be attached to the anterior abdominal wall. The umbilical scar was replaced by a dark purplish red fungating tumor 5 centimeters in diameter and raised 1 centimeter above the skin surface. In the skin 1 centimeter

below this and slightly to the right was a hard nodule 2 centimeter in diameter.

At roscopic examination of the tissue removed from the umbilical tumor showed it to be a typical adenocarcinoma. Barium enema revealed in it regular annular constriction of the cæcum. The plate also showed suggestive shadows of gall stones.

Operation. Ileostomy was performed February 21, 1925 by Dr. C. A. Hedblom.

A midline suprapubic incision was made. There was a moderate amount of free serous fluid in the peritoneal cavity. A very much dilated and hypertrophied loop of small bowel presented. There was a carcinomatous nodule on the peritoneum just to one side of the incision between the pubis and umbilicus. Exploration showed a large mass in the ascending colon which was adherent to the parietal peritoneum. The whole mass was perhaps 8 to 10 centimeters in the direction of the bowel and was nodular and sclerotic. No further exploration was made. A loop of the terminal ileum close to the cæcum was lifted into the incision and sutured to the peritoneum for a permanent ileostomy. The wound was closed in layers to the loop.

The patient had an uneventful convalescence and was discharged from the hospital on March 31.

The umbilicus is a permanent record of intra uterine existence. Most of its diseases hark back to this period and have their origin in its abrupt termination. Until after birth the main blood stream of the organism flows through the umbilicus. Until a short time before this it encompasses outpocketings of the gastrointestinal and genito urinary tracts in the form of the omphalomesenteric duct and the urachus. It is not uncommon for these to remain patent or for portions of them to become pinched off and persist as cell rests or cysts. It is as if the viscera retreating hurriedly into the peritoneal cavity had jammed their tails in this hastily closed door. The umbilicus may contain therefore, besides the normal squamous epithelium epithelium of intestinal bladder or even gastric type. All of these may give rise to primary carcinoma.

It remains also as a route of communication between the venous and lymphatic systems of the peritoneal cavity and the body surface.

# CHONDRODYSPLASIA<sup>1</sup>

By WALLACE H. COLE, M.D., F.A.C.S., St. Paul, Minnesota

**C**ARTILAGINOUS tumors are frequently found in the human body and of these the skeletal types are by far the most common. The classification is however far from clear because of the marked variation in both the clinical and pathological characteristics of these tumors and the allied dystrophies and probably no definite lines of demarcation will ever be distinguished. These varied features to quote Ewing are "perhaps dependent upon the facts that cartilage is essentially an embryonal and transitory tissue and that cartilage cells although encased in a firm matrix have rather active proliferative powers possess amoeboid properties and are readily subject to metaplastic changes. One type of case which has appeared rather infrequently in the literature is the so called chondrodysplasia or Ollier's disease and the observation of what is apparently a unique case of this condition has led to the making of the following brief report.

Ollier in 1898 reported a case of cartilaginous dystrophy in which the extremities of one side of the body were as a result markedly retarded in growth and to which he gave the name of dyschondroplasia. In 1900 Molin working under Ollier published a thesis at Lyons entitled *Dyschondroplasia* a Roentgenological and Clinical Study to which an introduction was written by Ollier and in which three cases of the condition were reported one of these being the original case of Ollier. All of these showed a typical asymmetry although in one there was a crossed distribution the right lower and the left upper extremities being involved. According to Ollier the condition is characterized by irregularity and retardation of ossification at the epiphyseal cartilage for this cartilage does not submit to the normal process of ossification but persists as cartilaginous masses and nodules which take a long time to transform themselves into bone. These nodules may be superficial or deep that is subperiosteal or medullary. The condition is observed most

clearly in the phalanges of the fingers and toes principally the former all the affected bone being sometimes involved and sometimes only a part. It is as if little chondromata were disseminated in the tissue of the phalanx. In the long bones the tumors are in the juxta epiphyseal regions and when on the surface the more common occurrence resemble exostoses. When in the bone the juxta epiphyseal areas are transformed into transparent masses which are regularly swollen and more or less voluminous in this case the epiphysis remaining more cartilaginous than normal for the same age. The roentgenogram shows the deformed contour of the bones and the cartilaginous masses interrupted by denser white spots. Ollier's short definition of dyschondroplasia is "An affection of the period of growth with arrest of growing parts of the skeleton with nodosities and swellings of the extremities of the corresponding long bones curving of diaphyses and slight but constant deformities of the hands." He believed that the so called osteogenic exostoses and dyschondroplasia were identical. Nové-Jossier and who has also studied one case of this condition mentions the hemiplegic distribution as an important characteristic and differential point. Molin's study caused him to arrive at the following conclusions:

1. Dyschondroplasia is an osseous dystrophy characterized from a clinical point of view by partial arrest of development of the skeleton.

2. The disturbance of the bony growth affects by preference the long bones of the extremities and the metacarpophalangeal skeleton of the hand.

3. The long bones show curvatures analogous to those of rickets.

4. Joint deformities must be considered as the direct consequence of bony alterations.

5. Only the roentgenograph allows the nature of the dystrophy to be observed it approaches that of rickets and chondroma but does not completely simulate them.

picture is usually distinctive. No definite nodule develops; rather there appears a deep induration at the umbilicus which gradually takes on the appearance of a phlegmon. As the viscus perforates into the abdominal wall fluctuation occurs and incision at this time will often yield definite pus. The condition goes on to malignant ulceration, fistula formation, and discharge of gastric or intestinal contents.

Microscopically the primary growths are either typical squamous cell epitheliomata or adenocarcinomata of the intestinal type. A secondary tumor reproduces the characteristics of the original lesion. When this is in the intestine it is difficult to distinguish microscopically between primary and secondary growths.

#### SYMPTOMS

In primary growths the symptoms will be wholly local or those incident to metastases. In secondary tumors in most instances, there will be symptoms of advanced malignancy of one or another of the abdominal viscera. This is not always the case. In 14 of the secondary cases the umbilical nodule was the first thing noted and at the time of observation there were no symptoms referable to the original lesion, this being discovered accidentally at operation or at postmortem examination. This point is of considerable clinical importance making it requisite in all cases of carcinoma in this region to make a thorough search for a latent visceral focus. Occasionally there will be a history of a long standing umbilical hernia. In this case it is

probable that the growth is an extension of an ommental nodule adherent in the sac.

#### DIAGNOSIS

Carcinoma must be distinguished from many other tumors which may arise at the umbilicus. To recount them all and give their distinguishing characteristics is beyond the scope of this report. The more important of them are hernia, abscess, hypertrophy, adenomyoma, cysts (dermoid and those arising from remnants of the omphalomesenteric duct and the urachus), benign tumors of vascular, lymphatic, fat, or connective tissue origin, and sarcomata.

#### CONCLUSIONS

1. A case is reported of cancer of the umbilicus secondary to adenocarcinoma of the caecum.

2. There is presented a clinical and pathological summary of the 107 instances of carcinoma of the umbilicus which to the present time have appeared in the literature.

I wish to express my thanks to Dr. C. A. Hedblom upon whose service the case occurred, and who was kind enough to allow me to report it, also to Dr. E. M. Medlar who examined the tissue removed at biopsy and made the microscopic diagnosis.

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- Those who did work in this field will be infinitely grateful to Dr. I. S. Culliv for his generous help.

cases found in the literature by Ehrenfried, only 5 or 6 showed a marked asymmetry (Molin's cases etc.) Hereditary relationship in this series was present in about 60 per cent of the cases. Roentgen examinations showed typically juxta epiphyseal hyperostoses particularly around the larger joints with squaring off of the bones entering into the knee joint. Enlargements at the metaphyseal ends of the bones were thin in density and mottled or striated in the younger patients but denser and with longitudinal striations in the older cases. Bubble like vacuolation suggesting cysts present particularly in the ulna radius and fibula were very characteristic. Ehrenfried found that all the bones of the body could be involved but the cranium very rarely so.

Carman and Fisher have reported a case of multiple congenital osteochondromata in a man 30 years of age in which all the bones of the body except the skull and face were involved. The microscopical structure showed a persistence and overgrowth of poorly ossified or calcified cartilage with the cells irregular in size and form.

Ashhurst under the heading of Multiple Cartilaginous Exostoses Hereditary Deforming Chondrodysplasia reviews Ehrenfried's work and some of the other literature and reports 11 cases of the condition observed by himself. He states that the underlying pathological change in cases of this sort is a chondrodysplasia affecting the metaphyses of the long bone with the exostoses being merely incidental and not the essence of the disease. No hereditary character was apparent in his series.

Bentzen has recently published a report of a case which is typically of the type under discussion.

A girl 15 years of age gave a negative family history. When she was 5 years old the parents noticed that her right leg was shorter than the left and from that time on the shortening had become more pronounced. When she was 11 years old the right femur was fractured by a simple fall from a bicycle. The lesion occurred at a point where a subsequent examination showed rather extensive changes in the bone. Two other fractures occurred at different times in the upper extremities due to severe injuries and had apparently nothing pathological in their etiology. At the time of the examination the leg was 8 centimeters shorter than the other and as a result there was a

long right total scoliosis. Roentgenograms showed very remarkable structural changes in the bones of the right lower extremity and pelvis the rest of the skeleton being negative except for an anomaly of the second dorsal vertebra. Films taken when the child was 7 years of age were at hand for comparison but aside from the fact that a certain amount of healing seemed to have taken place there was little difference in the pictures. Both metaphyses of the tibia showed longitudinal stripe shaped clear areas as if long chips had been taken out with a gouge and a similar picture was present in the wing of the ilium the stripes being arranged in a rather irregular fan shape. The lower end of the femur was involved in the same way but around the region of the lesser trochanter there were spot shaped clear areas. In the foot the first phalanx of the second toe was definitely involved and two clear spots were seen in the first phalanx of the great toe.

Bentzen was able to find twelve cases of Ollier's disease in the literature but his was the first one recorded where only one extremity the right lower was involved. (The twelve cases recorded are Nove Josseland 1 Ollier and Molin 3 Wittick 1 Coon 1 Koehler 1 Burchardt 2 Bojesen 1 Johanson 1 and Johannessen 1.) His study showed that although these cases differed from each other in some ways the roentgenograms were very characteristic and allowed the condition to be distinguished from all other known diseases of bone. The differences are due mostly to the different stages obtained and where the changes are great the stripes and spots disappear and the bone becomes very much deformed. All of the authors agree that the clear areas seen either as stripes or spots are due to cartilage being present where bone is normally found and the consensus of opinion is that these cartilaginous masses are not true tumors. Bentzen found a hemiatrophy of the face in his case and this was also reported in three of the twelve cases mentioned the atrophy being on the same side as the involved extremities. The fact that this symptom is one which is found in lesions of the upper sympathetic tract together with the observations that the distribution of the peculiar striping in the involved bones is apparently the same as the distribution of the blood vessels in the bones and that the lesion is so typically asymmetrical led Bentzen to undertake a series of experiments on rabbits in which either the sympathetic cord was de-



6 The definite isolation of this condition cannot be made on account of the absence of complete microscopical and macroscopical findings

7 The identity of dyschondroplasia and osteogenic exostoses needs further pathological-anatomical control

8 The etiology is absolutely unknown

The three cases reported by Molin are briefly as follows

CASE 1. Girl aged 10 years with practically a negative history, developed a slight lump when 5 years of age and was found to have at that time a shortening of from 2 to 3 centimeters. Examination showed a hemiatrophy of the right side, the hand and foot being also both involved. The right upper extremity was 6 centimeters shorter than the left and the lower extremity 8 centimeters shorter than on the opposite side. The deformities were a compensatory scoliosis and an equinus position of the foot on walking.

CASE 2. Girl aged 17 years gave a negative history. At 3 years of age a deformity of the right knee was noticed and about the same time a deforming lesion of the left hand was found. At the time of the examination a marked genu valgum was present and the right lower extremity showed 10.25 centimeters shortening. A later observation on this same case showed a subluxation of the hip on the affected side and a valgus deformity of the knee of nearly 90 degrees.

CASE 3. Boy aged 6½ years gave a negative history. The child learned to walk at 11 months of age and shortly after this a slight lump was noticed. On examination the right arm was found to be about 5 centimeters short and the right leg 5.5 centimeters short.

Coon in 1911 reported a case which after a search of the literature seemed to be at that time the only additional case of dyschondroplasia after Molin's on record.

Coon believed that the only true diagnostic method was the roentgenogram, the only similar picture being that of multiple cartilaginous exostoses.

The patient a boy aged 15 years gave a negative family history and his previous history showed apparently nothing which could be directly connected with his condition. When he was less than 3 years of age a swelling was noted in the region of the right wrist following an injury a few weeks before and from this time on other lumps appeared in both the upper and lower extremities on the right side and the parents noticed that these extremities were not growing as fast as those on the left. When he was 13 years of age some small lumps had appeared on the

left hand. The examination of the boy showed the right side to be much deformed, the upper extremity being 6.25 inches shorter than the left and the lower extremity 3 inches shorter than the opposite side. The wrist and elbow were widened and masses could be felt on the humerus but although the knee was thickened and there was a slight roughness of the metatarsals no such masses could be made out in the affected lower extremity. A slight degree of genu recurvatum was also present and the right foot was smaller than the left. The femur tibia fibula and ulna on the right showed abnormal curves. The roentgenograms were very striking and showed much more bony involvement than was apparent clinically. Three different types of such involvement were observed. The first type which was present also on the left side was confined to the metatarsals metacarpals and phalanges and showed areas of lessened density with tumor formation which probably represented true chondromata. The second type was present at each end of all the larger long bones of the affected extremities and showed irregularity of outlines, increase in density and a peculiar longitudinal striation with no tumor formation. The third type of involvement showed exostoses these occurring on the olecranon acromion and coracoid processes and on the shaft of the humerus.

Ehrenfried has apparently made the most exhaustive search of the literature on cartilaginous tumors and has written two articles on what he calls Hereditary Deforming Chondrodysplasia—Multiple Cartilaginous Exostoses. The condition thus described covers a large group of cases the characteristics of which are briefly as follows. It is an affection of the period of skeletal growth which is first noted usually in infancy or childhood the manifestations increasing with skeletal growth and ceasing with skeletal maturity. The lesions consisting of cartilaginous and osteocartilaginous growths within and on the skeleton are multiple and more or less symmetrical and result from a disturbance in the proliferation and ossifications of the bone forming cartilage. Certain typical distortions and deformities of the skeleton occur and in the majority of the cases studied the ulna and the fibula were disproportionately short in relation to the radius and tibia with resulting deformities of the hands and feet. The fingers and toes showed bulbous juxta epiphyseal enlargement with frequent irregularity as to length. The condition is apparently generally symmetrical with minor differences only 100 out of the more than 600



Fig 5

Fig 5 Roentgenogram of thigh and leg anteroposterior position



Fig 6

Fig 6 Roentgenogram of thigh and leg lateral position



Fig 7

Fig 7 Roentgenogram of ankle and foot lateral position

free These cases showed a longitudinal striation in the metaphyses of practically all the long bones in the body and the fan shaped striation in the wings of the ilia as previously

described in Bentzen's case Voorhoeve's article goes into the literature very carefully and is one of the best discussions of the subject under consideration that has appeared



Fig 4 Roentgenogram of pelvis and thighs

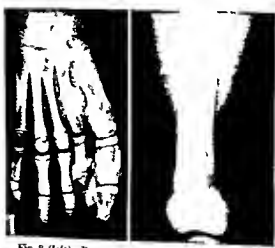


Fig 8 (left) Roentgenogram of front of foot  
Fig 9 Roentgenogram of left thigh and knee anteroposterior position



Fig 1

Fig 2

Fig 3

Fig 10

Fig 1 Front view of patient with weight borne on left or sound leg

Fig 2 Side view both feet on the ground

Fig 3 Side view of patient with weight borne on left or sound leg

Fig 10 Lateral view of patient fitted with raised shoe

stroyed or the region of the nutrient artery injected with alcohol and any bone changes followed with the roentgenogram and microscope. The results were positive in two animals and led Bentzen to the following conclusions:

1 Ollier's disease may be interpreted as the typical reaction of the bones against an active hyperemia of the bone tissue arising owing to anomalies in the vegetative nervous system that is disorders in the innervation of their blood vessels. (The anomaly in the second dorsal vertebra is discussed as to its possible relation to a sympathetic lesion at that level.)

2 The pathological processes in the bony tissue may be assumed to be related to the phenomena seen in the formation of callus.

White has observed two cases which he calls 'Hereditary Deforming Chondrodysplasia' both of which had multiple cartilaginous exostoses. The condition was apparently of the symmetrical type in both cases.

Voorhoeve of Amsterdam has published an account of a condition which he believes is to be classed as dyschondroplasia and which was present in a rather marked and symmetrical degree in a brother and sister and to a lesser extent in the father the mother being

a separate entity especially as some of these cases such as Coon's and the one just reported show slight changes also on the opposite side of the skeleton. If the term 'Ollier's disease' is to be used it should be used to describe the asymmetrical cases only but with the understanding that the cases so named are only a small division of the large group of cartilaginous dystrophies called by various names but by Ehrenfried 'hereditary deforming chondrodysplasia'. Although heredity seems to be a factor in a certain percentage of these cases there are so many others especially the asymmetrical type which have no apparent hereditary basis that it seems as if the omission of this term would be more suitable when naming the lesion. It is interesting to note the similarity between certain parts of the case being reported and the various cases reported in the literature. Ollier lays stress on the roentgenological picture of rarefied areas with denser white spots scattered throughout. This picture is seen very typically in the lower end of the femur and in both ends of the tibia in the author's case. Both Ollier and Coon speak of the areas of lessened density in the phalanges Ollier describing them as similar to a small chondroma. This picture is similar to the one seen in the foot in the present case and the irregularity in the length of the toes which Ehrenfried brings out in his article is also present. The striations which seem to be such a striking feature of some reported cases and which have even been reproduced experimentally in rabbits were not present in the case under consideration unless the appearance in the neck of the femur can be interpreted as such. Many roentgenograms of cases of proved osteitis fibrosa show a condition in the bone which simulates very closely that seen in some of the reported cases of chondrodysplasia but at no place in the

films of the present case could such a condition be diagnosed and the differentiation should not be difficult.

#### CONCLUSIONS

The conclusions to be drawn from this brief review seem to be

1 Ollier's disease is a term which seems fixed in the literature but which should be used only to designate those cases of cartilaginous dystrophy with or without cartilaginous tumor or exostosis formation which show an asymmetrical involvement of the body as the outstanding clinical feature.

2 Chondrodysplasia (a term preferable to dyschondroplasia) is a condition which is usually asymmetrical but as several symmetrical cases are on record the term must therefore be broader in its application than Ollier's disease.

The gradation of reported cases between those of frank multiple cartilaginous exostoses on the one hand and the so called chondrodysplasia with no change in anything but the internal architecture of the bones (Voorhoeve's cases) on the other is so varied and irregular that a definite classification of cartilaginous dystrophies is still impossible. The possibility that the apparently widely different findings in some of these cases are only manifestations of different stages of the same condition must not be overlooked.

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A very complete list of the literature on chondrodysplasia will be found in the first two of the above. The author's list comprised practically the same references.

Very recently Fairbank has reported "A Case of Unilateral Affection of the Skeleton of Unknown Origin" in a boy 12 years of age which he does not believe can be classified under the heading of chondrodysplasia but which one reading the description and seeing the published roentgenograms is inclined to place in that class. The condition was confined to the right side of the body and the right leg was one half inch longer than the left, a finding which is used as an argument against the diagnosis of chondrodysplasia as all reported cases of that condition show shortening of the affected extremities. The roentgen appearance is that of atrophy striation and a sprinkling of dense spots with no alteration in the contour of the affected bones.

Jansen has just reported a case of Unilateral Chondromatosis (Ollier's Disease) in a 9 year old girl. The left side of the body was involved but a few suspicious areas were also seen in the roentgenograms of the right side. The face was asymmetrical but no lesion of the sympathetic system could be demonstrated. Pathological tissue showed cartilaginous masses with bone marrow and blood vessels in the center. No fibrous tissue was found.

The author's case which led to the search of the literature the results of which are briefly summarized above follows.

A girl aged 11 years came into the hospital the complaint being that the right leg was markedly shorter than the left. This shortening had been present since birth and the doctor who saw the child at that time said it was probably due to maldevelopment. The family history was negative and no similar condition had ever been present in any of the members of the father's or mother's families immediate or remote. The patient had the usual diseases of childhood with no complications.

Examination at the time of admission showed a marked shortening of the right lower extremity with enlargements at the lower and upper ends of the tibia and the lower end of the femur and a palpable mass on the medial side of the shaft of the femur. These enlargements were hard and firm and felt like definite tumor masses. There was a marked varus deformity of the knee and a permanent flexion deformity of about 15 degrees was present in this joint (Figs 1 & 2). Measurements showed approximately 20 centimeters shortening of the right lower extremity as compared with the left the measurements being taken from the anterior superior spines to the medial malleoli. There was a marked shorten-

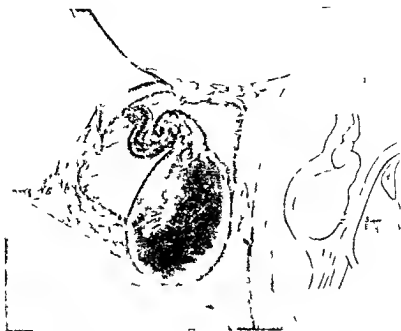
ing of the second toe of the right foot but no other apparent lesion below the ankle. The ankle joint was apparently normal and the knee joint showed practically a normal range of motion.

A roentgen study of the skeleton disclosed a peculiar condition present most prominently in the right ilium femur tibia and second metatarsal bone of the foot. The upper extremities and spine were apparently negative. The right ilium showed in its wing a vacuolated area with increased density around it and rarefied areas above the acetabulum. The pubic bone showed slight similar changes. The right femur was much shorter and thicker than normal and two large tumor masses were present one apparently originating from the shaft near its center and causing distortion with a smoothly surfaced although slightly irregular vacuolated mass projecting medially and the other occupying the lower end of the bone and causing a symmetrical swelling with intact outline but showing in its body a very striking mottled appearance (Figs 4 & 5).

The upper and lower ends of the right tibia showed swellings similar to that in the lower end of the femur (Figs 5 & 6). The fibula was apparently not involved and as a consequence was very long in comparison to the shortened and thickened tibia. The first and second metatarsal bones of the right foot and the phalanges of the great and second toes and to a lesser extent of the other toes were involved and showed a series of vacuolated areas with dense striations in and around them (Fig 8). The shortening of the second toe was seen to be due to the condition in the second metatarsal bone. The left femur showed a slight thickening and spindle like enlargement in its middle (Fig 9) and the upper end of the shaft and the neck showed definite rarefied areas with no tumor formation (Fig 4).

A biopsy was performed and a portion of the tumor mass in the upper end of the tibia was removed. Grossly the mass was cartilaginous with a thin bony shell. The microscopic sections showed mainly cartilage with small areas of bone distributed throughout. There was also well developed fatty bone marrow with areas of red bone marrow. A diagnosis of chondrodysplasia with the formation of osteochondroma was made the benign character of the lesion being assumed (Dr E. T. Bell). No treatment seemed to be indicated so the child was fitted with an extension sole on the shoe which made up for the shortening (Fig 10).

A study of the roentgenograms of this case together with the findings in the literature which have been outlined above seemed to make the diagnosis of chondrodysplasia fairly certain. It seems impossible to separate absolutely the various types of cartilaginous tumors and dystrophies from each other and undoubtedly they are all related in a certain way and it is therefore questionable whether the asymmetrical cases should be classified as



Appearance of varix after dissection from its bed  $\times 2$ , actual size. It lies over the saphenous vein and femoral triangle. Insert shows lateral view of varix and its relation to other veins.

compression over the femoral ring gave the impression that the swelling was permanently reduced. There were no varicose veins of the leg. The thrill described by other observers was not felt. Possibly the dilated veins over the lower abdomen should have aroused suspicion but unfortunately so far as an accurate diagnosis was concerned they did not. The duration of the swelling 6 years was also unusual most of the reported cases having been noticed only for a period of a few weeks or months.

#### CONCLUSION

A varix of the superficial epigastric vein is reported. Though such a condition of the saphenous is not unusual its occurrence in this particular vessel is apparently unique.

The usual diagnostic signs were absent in this case possibly accounting for the erroneous clinical diagnosis of femoral hernia.

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## VARIX OF THE SUPERFICIAL EPIGASTRIC VEIN SIMULATING FEMORAL HERNIA

By WALTER HUGHSON M.D. Baltimore

From the St. Joseph's Hospital and Medical School

**C**ONFUSION in the differential diagnosis between varices in the femoral triangle and actual femoral hernia is a matter of fairly common occurrence. Numerous reports of clinical cases appear in the literature some of which have been diagnosed before operation and others not. A case is presented which is apparently unique in that the varix was of the superficial epigastric vein rather than of the saphenous. This fact may also account for the absence of some of the usual diagnostic signs of the condition.

The recognition of varices in the region of the femoral triangle according to de Quervain should present no particular difficulty. Though referring to dilatation of the internal saphenous alone he says: Fusiform or saccular dilatation of the vein disappears at the least pressure and reappears the moment the pressure ceases. Besides the least variation of intravenous pressure such as that caused by coughing and changes of position of the body causes variation in the volume of the tumor; the bluish color of the blood sometimes shows through the skin. The signs are so clear it would seem impossible to make an error in diagnosis. It has however already been done.<sup>1</sup>

Coley lists the diagnostic signs as follows:

1. Instead of suggesting a solid body on palpation it has a peculiar thrill as if fluid were being forced through a compressible tube.

2. If the tumor is reduced and fingers pressed over the femoral opening and tumor slowly reforms it is a saphenous varix.

3. In nearly every case there are well marked varicose veins.

These general points are emphasized also by Coopernail, Stetten, Noehren, Sistrunk, Erdman and others who have reported cases and discussed the diagnosis. Several instances of incorrect diagnosis of femoral hernia of which the present case is one are in the literature the condition being recognized only at operation.

**CASE 1.** M. H. S. white female married age 52 years complained of a lump in the left groin.

**Past history.** Appendectomy in 1905 was followed by ventral hernia. Repair of ventral hernia was made in 1922 and again in 1923. The patient has had 4 pregnancies a miscarriage occurring each time.

**Present illness.** Six years ago the patient first noticed a small lump in her left groin. This has slowly increased in size but most rapidly during the past year. The swelling is barely noticeable while the patient is lying down but becomes larger when she is standing or walking. She has not noticed any increase in size on coughing. For the past year the patient has felt a dull aching pain in the region of the swelling. This pain does not radiate and is more severe when the patient is standing up. There has never been any evidence of inflammation about the swelling.

**Physical examination.** The patient is a rather obese white woman. Examination is essentially negative except for the scar of a right rectus incision (hernia repair) a few dilated veins over the lower part of the abdomen and the local condition. In the left femoral region can be palpated a small soft mass about 4 centimeters in diameter easily compressible. An impulse is felt on coughing. In the erect position the mass increases somewhat in size and extends further toward the median line. There is no discoloration of the tissues. Extremities are normal.

**Diagnosis.** Femoral hernia reducible.

**At operation.** May 16 1925 the usual incision was made and carried down through a thick layer of subcutaneous fat. As the tumor was approached it was seen to be of a purplish color. Particular care was taken in dissecting it and prompt recognition of its character made. At about 1 centimeter from its entrance into the saphenous vein which was entirely normal the superficial epigastric vein was found to be greatly dilated. This varix measured about 4 by 6 centimeters the upper pole lying just below Poupart's ligament where the vein pursued its normal course though still about 3 times its normal size and markedly sclerotic. When emptied the varix was found to fill very slowly from above and rapidly from below the walls were thin and there was no evidence of thrombosis. Proximal and distal ligatures were applied and the varix excised. There was no sign whatever of a femoral hernia.

Healing was prompt and the patient made an uneventful postoperative recovery. There was no indication of tumor on discharge.

The diagnosis in this case was undoubtedly obscured by the particular position of the varix (Fig. 1). Reduction of the tumor and

- 1 Perforating wounds
  - Entrance
  - Entrance and exit
  - Abdomino thoracic wounds
- 2 Non perforating
- 3 Ruptured viscus either intestine or solid organ

As we have only shock and the presence of free fluid as a means of diagnosing non penetrating wounds early exploration is the only treatment

When a surgeon receives a patient with a diagnosis of acute abdomen from the family physician the first question he asks is Is this an acute surgical abdomen or a referred pain from some thoracic lesion as for instance acute pneumonia or diaphragmatic pleurisy or is it the gastric crises of locomotor ataxia gastro enteritis or any other non surgical disease?

It is not the purpose of this paper to discuss the diagnosis of the acute abdomen but to warn every surgeon to make his own diagnosis and if there is time to make a blood count I should much prefer a complete count In any case it is better to depend upon clinical observation than to hold up the operation until the laboratory is heard from Experience has taught that a diagnosis must be made independently of that made by the physician who refers the patient

Morphine should not be used until an operation has been decided upon When it is necessary to move the bowels enemas should take the place of cathartics

It has been well said that an operation had better be done early than well but it should not be undertaken until the surgeon is satisfied by a careful analysis of the history and a painstaking examination that he is dealing with an acute abdomen The surgeon must possess trained powers of observation an open mind and quick decision and having made his decision he must proceed directly to each step in the treatment in order to succeed

The points to be considered are time of operation the choice of anæsthetic lastly the method of operation (incision treatment of the disease closure of wound)

In dealing with the acute abdomen we are facing one of two conditions first pus or in

fectured material has either burst into the peritoneal cavity or is threatening to do so or because of a perforating wound, the contents of the intestine is soiling the peritoneum In the second instance we have the rupture of a viscus or a tumor either through trauma or torsion or disease within the viscus as an acute hæmorrhagic pancreatitis Here the time to operate is immediately unless the patient is in a state of severe shock In the first instance if we are dealing with an unruptured abscess the program is simple but if rupture has taken place or if through a perforating wound the abdomen is becoming contaminated the peritoneal cavity may be in what has been described as (1) the stage of contamination (2) reaction (3) stage of peritonitis

The operative procedure depends upon which of these three stages we have reached It is to be understood in this discussion that the patient is not too badly shocked to undergo an operation if it is conducted rapidly and as a life saving measure The problem before the surgeon at this point is the extent of absorption We will first discuss the absorptive power of the peritoneum with regard to the character of the fluid about to be absorbed I am using this term to include all solid particles floating in the fluid as debris pus corpuscles and bacteria We know that hypotonic fluids absorb readily, and that hypertonic fluids are reduced to isotonic by peritoneal exudate before absorption can take place

Leathes and Starling (Hertzel) found that 39 per cent of a hypotonic solution was absorbed in the first half hour At the end of 2 hours 49 per cent was absorbed The slowing of absorption was due to the establishment of osmotic equilibrium The absorption of blood begins in about 4 hours and is complete in about 48 Large solid particles are enclosed by exudate Smaller ones are absorbed by the blood stream It has been shown that the blood stream carries off the fluids faster and to a greater degree than the thoracic duct (McGuire) Experimentally lymphaticostomy for the prevention of toxæmia from peritonitis has so far failed Certain drugs injected into the peritoneal cavity have been



SURGICAL MANAGEMENT OF THE ACUTE ABDOMEN<sup>1</sup>

By W. M. THOMPSON, M.D. I.A.C.S. CHICAGO

THE title 'acute abdomen' was first used by W. H. Battle in 1911 as a substitute for the more prolix 'acute conditions within the abdomen' or the less definitely descriptive 'acute abdominal crises'. Since then because of its brevity and terseness it has been given the stamp of approval by the surgeons who have written upon this condition.

As an introduction to my subject the surgical management of the acute abdomen I will review briefly the causes together with their results.

Of all the definitions of the acute non-traumatic abdomen that of Deaver appears to be the most satisfactory. He says it is a sudden onset of acute abdominal pain preceded or followed by nausea or vomiting or both with tenderness and rigidity over the whole abdomen as a rule but more pronounced over the most painful area which is suggestive of the site of the lesion with or without depression or shock.

The acute surgical abdomen is divided into non-traumatic and traumatic. The causes of acute non-traumatic abdomen are

## 1 Infections

Appendicitis  
Acute cholecystitis  
Pyosalpingitis

## 2 Inflammatory lesions

Perforating ulcer  
Duodenal  
Gastric  
Typhoid

## 3 Misplacements, torsions, and abnormal conditions resulting in intestinal obstruction

Bands  
Postoperative adhesions  
Ovary  
Tumors  
Spleen  
Mesenteric thrombosis

## 4 Rupture

Intestine  
Pancreas hemorrhagic pancreatitis  
Ectopic pregnancy  
Spleen  
Uterus

## 5 Hernias incarcerated

Abdominal  
Inguinal  
Internal  
Postoperative

The crisis of the acute abdomen may be the dissemination into the abdominal cavity of fluid (1) either blood or cystic contents or the contents of the stomach and upper intestinal tract at first relatively sterile but not long remaining so (2) pus from the appendix and fallopian tubes (3) infected bile or pus from the gall bladder (4) the contents of the lower intestinal tract which increases in degree of infection as we progress downward.

The acute abdomen in infancy and childhood needs special mention because abdominal pain in children does not at first excite any special alarm hence children are often neglected. The diagnosis requires a combination of objective findings and a certain amount of intuition. Abscesses in children are less likely to be walled off. The omentum is smaller than in the adult and cannot act as easily as a dam against infection. Children do not usually stand operation as well as adults but they generally show good powers of recovery. Abscesses in fat or robust children are usually of the fulminating type.

In infancy and childhood the chief cause of acute abdomen are

1 Acute appendicitis  
Intussusception

3 Pneumococcal peritonitis a rare disease usually found in the female

The traumatic abdomen may be divided into those which present evidence of internal injury and those which do not.

- 1 Perforating wounds
  - Entrance
  - Entrance and exit
  - Abdomino thoracic wounds
- 2 Non perforating
- 3 Ruptured viscus either intestine or solid organ

As we have only shock and the presence of free fluid as a means of diagnosing non penetrating wounds early exploration is the only treatment

When a surgeon receives a patient with a diagnosis of acute abdomen from the family physician the first question he asks is Is this an acute surgical abdomen or a referred pain from some thoracic lesion as for instance acute pneumonia or diaphragmatic pleurisy or is it the gastric crises of locomotor ataxia gastro enteritis or any other non surgical disease?

It is not the purpose of this paper to discuss the diagnosis of the acute abdomen but to warn every surgeon to make his own diagnosis and if there is time to make a blood count I should much prefer a complete count In any case it is better to depend upon clinical observation than to hold up the operation until the laboratory is heard from Experience has taught that a diagnosis must be made independently of that made by the physician who refers the patient

Morphine should not be used until an operation has been decided upon When it is necessary to move the bowels enemas should take the place of cathartics

It has been well said that an operation had better be done early than well but it should not be undertaken until the surgeon is satisfied by a careful analysis of the history and a painstaking examination that he is dealing with an acute abdomen The surgeon must possess trained powers of observation an open mind and quick decision and having made his decision he must proceed directly to each step in the treatment in order to succeed

The points to be considered are time of operation the choice of anesthetic lastly the method of operation (incision treatment of the disease closure of wound)

In dealing with the acute abdomen we are facing one of two conditions first pus or in

fect material has either burst into the peritoneal cavity or is threatening to do so or because of a perforating wound, the contents of the intestine is soiling the peritoneum In the second instance we have the rupture of a viscus or a tumor either through trauma or torsion or disease within the viscus as an acute hemorrhagic pancreatitis Here the time to operate is immediately unless the patient is in a state of severe shock In the first instance if we are dealing with an unruptured abscess the program is simple, but if rupture has taken place or if through a perforating wound the abdomen is becoming contaminated the peritoneal cavity may be in what has been described as (1) the stage of contamination (2) reaction (3) stage of peritonitis

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recovered in the thoracic duct but much slower and in a smaller quantity than through a urethral fistula. Laboratory experiments are helpful in so far as they demonstrate the absorbing power of the peritoneum but no worker has been able to reproduce the pathology and the septic fluid found in the acute abdomen.

It has recently been shown that fluids are absorbed with equal rapidity from all parts of the peritoneal cavity which is contrary to the conception of former physiologists who believed that the greater absorption took place in the region of the diaphragm. The movements of the diaphragm may increase the rate of absorption in that region but the capacity to absorb is equal over all the peritoneum. In the early stages of rupture of an abscess absorption is hastened. As soon as hyperæmia and inflammatory exudate appear together with damaged endothelium absorption is delayed. Wagner found that increase in abdominal pressure hastened absorption as long as increased pressure is not great enough to retard the flow of blood. The factors which delay absorption are drugs such as opium or albumin added to the abdominal fluids or in solution. A profuse peritoneal exudate is no good omen for the patient. In the intraperitoneal conditions in which intra abdominal pressure is increased as for instance tympanites in peritonitis if the pressure is sufficient to check the circulation within the abdomen caution should be used in reducing the intra abdominal pressure for tympany here is a conservative factor. If too free incisions through the abdominal wall relieve this pressure undesirable absorption is increased. It goes without saying that unwise manipulation increases absorption. In the stage of contamination of the peritoneum there are three possibilities to be considered.

1 Material may be introduced in such quantities that death by intoxication may result before the defensive functions of the peritoneum can be mobilized. Thus we have the possibility of death by absorption of toxins before the reactive factors could be set into action that is before peritonitis could develop.

2 Small doses of bacteria might be destroyed before they could do harm.

3 Stagnating fluids in the peritoneal cavity would favor the development of bacteria. Thus the amount of infectious material, the kind of bacteria and the state of preparedness of the peritoneum are the important factors. In the presence of these conditions there is no surgical procedure that demands more highly trained and co-ordinated assistants.

Local anesthesia should be chosen for the first stage for the infiltration of the abdominal wall and blocking of the lower thoracic and abdominal nerves procaine and adrenalin being used. In an encysted abscess it is possible to cofferdam the abdominal contents from the abscess, evacuate the abscess by suction and infiltrate the mesentery of the caecum in appendicitis or do a subperitoneal infiltration in the region of the splanchnic nerves in duodenal or gastric ulcer. Successful intra abdominal anesthesia depends upon negative intra abdominal pressure and this is not always possible in the face of an invading infection so that it is often best to resort to gas oxygen analgesia while adhesions are being removed. In the stage of peritoneal reaction before sufficient intraperitoneal pressure has developed to delay absorption local anesthesia may suffice.

If material in sufficient quantities has been introduced into the peritoneal cavity to cause death by intoxication gas oxygen with a small percentage of ether may be the anesthetic of choice. In those cases in which vomiting is a troublesome symptom it is advisable to wash out the stomach and in patients in whom the contents of the small intestine are liable to continue to regurgitate the stomach tube may be left in for further emptying and lavage. Acidoses and blood concentration can be prevented by hypotonic solutions introduced subcutaneously or intravenously. The rectal injection of water or normal salt solution may stimulate peristalsis a condition to be avoided and it has been found that hypodermoclysis can be maintained for sufficient length of time to saturate the tissue. It is also to be borne in mind that this tissue saturation may slow up absorption.

from the abdominal cavity. Since it has been found that acidosis following anaesthesia is one of phosphoric acid and not an organic acid surgeons have abandoned sugar solutions which only add to the hyperglycaemia and are using hypotonic salt. For the treatment of haemorrhage and shock blood transfusion takes precedence over all measures.

In the stage of peritonitis if it is thought advisable to adopt the Murphy drainage method of operating local anaesthesia is best. If on the other hand a radical incision is to be made there are two reasons for using general anaesthesia of gas oxygen and ether. First the necessity for rapid anaesthesia and second the desirability of maintaining sufficient intra abdominal pressure to prevent undue absorption. In such an operation packs intra abdominally sandbags along the side of the walls of the abdomen and the assistance of the interne's hands may be used to maintain pressure.

Shock is an important factor in the treatment of abdominal cases. To anticipate shock is better than to be compelled to stop an operation and rally all the forces of the operating room to treat shock. We are all familiar with the signs of impending shock and I believe that every well equipped hospital should have its house staff trained to combat this condition in its incipency.

In selecting the site for the incision we are influenced by two factors—the accessibility to the lesion and the prevention of infection of the general peritoneal cavity. In acute lesions in which walling off is not to be expected accessibility generally speaking is the dominant factor while later when there is a partial or complete walling off the prevention of infection is the more important. Conservatism should be the aim of the surgeon. The acute abdomen is an emergency and enough should be done to place the patient out of danger.

To complete a cure it may be necessary to do a two stage operation bearing in mind that the first is life saving. It is a temptation particularly to young surgeons who are developing their technique to prolong an operation unduly in their enthusiasm to perform a brilliant and spectacular operation.

The laws of physiology, not the laws of hydrostatics are those which must be studied in attempting to solve the problem of drainage. As a general principle gauze should not be left in contact with the coils of the intestines but layers of porous non adhesive material such as bobinette saturated with paraffin or perforated rubber tissue should be interposed between the intestine and the gauze. A rubber tube or an accordion rubber drain should be the choice for encysted abscesses. In acute peritonitis where it is decided to use the Murphy incision a rubber tube of sufficient caliber should be placed deep in the pelvis through a low central incision with cigarette drains through stab wounds in the flank and over the dressings a snug fitting abdominal bandage should be applied. It is generally conceded that drainage is usually of no value after 48 hours.

Closure of the abdomen may be done in the single layer by means of the navus needle if the patient is in danger of collapse. If each layer is held by forceps and properly transfixed it is possible to get fairly good apposition but layer closure is better.

#### SUMMARY

The majority of acute non traumatic abdominal conditions develop from some chronic pathology. A careful review of the history is sometimes necessary to develop this fact. If the patient is too ill the relatives must be consulted in order to get a complete history. The extent of traumatic abdominal lesions can not be fully known except by operation. The experience in abdominal thoracic surgery in world war wounds has shown that in operations performed within 10 hours of the time the wound was received bold radical surgery was conservative. I believe the same rule holds in the treatment of the early stage of peritoneal contamination. Later when peritonitis has set in before it is decided whether to operate or not or whether a conservative or radical operation is to be done one should judge the resistance of the patient the extent of absorption and the amount of infection in the peritoneal cavity.

Perhaps it is better in the light of our present knowledge to warn against inter

ference in cases of peritonitis in which abdominal distention shows the approaching paralysis of the intestines, but I believe that laboratory experiment, clinical experience and observation will make possible an increasing number of patients that can be saved by a carefully thought out plan of surgical attack.

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## THE NON-SPECIFIC ANTIGENIC EFFECT OF SPERMATOZOA UPON FERTILITY<sup>1</sup>

By S J FOGELSON M.D. CHICAGO

From the Department of Pathology, North Central University, Chicago, Ill.

THE purpose of these experiments was to determine if possible a serological explanation for sterility in the human which had no apparent anatomical or physiological basis. Dittler, Kovacs, McCartney and others report temporary induction of sterility in rats by sensitization with rat spermatozoa. Waldstein and Ekler describe in rabbits a definite Abderhalden reaction to testicular protein following coitus.

Our object was to produce these antibodies experimentally in animals to note their effect on a known existing fertility and later to determine whether a similar sensitization to spermatozoa protein existed as a possible causative factor in human sterility. In addition we wished to determine:

1 Whether this effect were specific for species that is whether female animals sensitized by sperm of another species would give the same results as those sensitized by spermatozoa of the same species

2 Whether ovulation was effected by this sensitization

3 What mechanism caused this sterility precipitins agglutinins lysins or spermatoxins

4 What was the effect of sensitization upon females already pregnant

### TECHNIQUE

Female albino rats of the same family were used to eliminate familial variation. They were all about 100 days old and had already borne one litter thus establishing their fertility. A diet sufficient in vitamins was supplied as it has been proved that a deficiency of vitamins can readily induce relative sterility (6). The rats were kept warm in clean cages and supplied a varied diet of milk, green vegetables and table scraps. Long and Evans' method of determining the presence of estral cycle was used (5).

When a female was found pregnant for the first time it was isolated until delivery of this initial litter and 10 days later at 4 day intervals was injected intramuscularly with 100,000, 200,000, and 300,000 spermatozoa. Two weeks after the last injection active young males were put into the cages with the sensitized females and allowed to stay there continuously. Vaginal scrapings of these female rats were examined at regular intervals for the presence of estral changes care

being taken not to repeat this often enough to traumatize the vagina and thus impair fertility. In a similar fashion human and guinea pig spermatozoa were used as an antigen. Controls were other female rats of the same age and selected under the same conditions but injected with typhoid bacteria and extracts of male salivary gland. It was found in earlier work that when blood for serological tests was obtained by cutting off part of the rat's tail or otherwise traumatizing the rats fertility was impaired. The blood of the sensitized animals was obtained at the termination of the period of observation, animals whose blood was examined at other times were not listed in the results.

As an explanation for the mechanism of sterility search was made for the presence or absence of precipitins, agglutinins, lysins or toxins in the sera of the injected animals by testing the effect of such sera on active spermatozoa which were obtained by shaking them out of fresh testis into isotonic salt solution at 37°C. For precipitins the contact method was used while agglutinins, lysins and toxins were determined in hanging drops.

### RESULTS

The intramuscular injection of rat spermatozoa into female albino rats with technique as outlined induced a period of sterility varying from 6 to 22 weeks with an average of 12 weeks (Table I). This confirms the work of McCartney (21) which stimulated interest as to whether the sterility produced in this manner is necessarily specific for species. In order to determine this two series of animals were sensitized to human and guinea pig sperm. The results were significant in that rats injected with guinea pig sperm remained sterile from 6 to 29 weeks with an average of 14 weeks; those sensitized to human spermatozoa remained sterile from 3 to 26 weeks with an average of 14. Four rats whose sera had been used during the observation period and hence not listed in the results remaining sterile for over one year when they were killed for rats over 18 months old are worthless for this type of research approaching at this time their menopause (13). In contrast with these results, the controls after sensitization

TABLE I—SENSITIZATION OF RATS TO RAT SPERMATOOZOA  
(Results in 10 of a series of 40)

No.	Initial litter		Dates of injection	Results	Interval between mating of sensitized rats and litter
	Date	No.			
1	5-1-24	5	5-2-24 5-6-24 5-10-24	No preg	24 weeks
2	5-3-24	5	5-2-24 5-6-24 5-10-24	No preg	22 weeks
3	6-1-24	6	6-10-24 6-14-24 6-18-24	Litter of 5 9-15-24	12 weeks
4	6-3-24	5	6-10-24 6-14-24 6-18-24	Litter of 5 8-10-24	9 weeks
5	6-20-24	4	6-30-24 7-3-24 7-7-24	Litter of 4 9-1-24	8 weeks
6	6-25-24	7	6-30-24 7-3-24 7-7-24	Litter of 5 12-10-24	22 weeks
7	10-4-24	6	10-11-24 10-15-24 10-19-24	No preg	22 weeks
8	10-9-24	5	10-11-24 10-15-24 10-19-24	Litter of 5 3-3-25	19 weeks
9	12-15-24	6	1-3-25 1-7-25 1-11-25	Litter of 6 6-1-25	24 weeks
10	1-29-25	6	2-2-25 2-6-25 2-10-25	Litter of 5 3-15-25	6 weeks

Average of 40 rats of this series

12 weeks

with typhoid bacteria and salivary gland extract had their second litters in 5.5 weeks which is about normal for healthy rats.

Ovulation persisted throughout the entire period of sterility in all animals as demonstrated by the cyclic changes in the vaginal scrapings.

### SEROLOGICAL RESULTS

Precipitins for the spermatozoa used were specific up to dilutions of 1:128 in the sera of the sensitized animals, further readings were omitted because of the difficulty in reading the end point. This confirms Hektoen's results (9). The presence of specific precipitins was used as an indication of definite sensitization.

The question of agglutinins is of definite importance in sterility and despite the fact



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## THE NON-SPECIFIC ANTIGLYNIC EFFECT OF SPERMATOZOA UPON FERTILITY<sup>1</sup>

By S. J. FOEGLSON, M.D., CHICAGO

From the Department of Pathology, University of Illinois, Chicago, and the West Virginia Hospital

THE purpose of the experiments was to determine if possible a serological explanation for sterility in the human which had no apparent anatomical or physiological basis. Dittler Kovacs McCartney and others report temporary induction of sterility in rats by sensitization with rat spermatozoa. Waldstein and Ekler describe in rabbits a definite Abderhalden reaction to testicular protein following coitus.

Our object was to produce these antibodies experimentally in animals to note their effect on a known existing fertility and later to determine whether a similar sensitization to spermatozoa protein existed as a possible causative factor in human sterility. In addition we wished to determine

1. Whether this effect were specific for species that is whether female animals sensitized by sperm of another species would give the same results as those sensitized by spermatozoa of the same species.

2. Whether ovulation was effected by this sensitization.

3. What mechanism caused this sterility precipitins agglutinins lysins or spermatoxins.

4. What was the effect of sensitization upon females already pregnant.

### TECHNIQUE

Female albino rats of the same family were used to eliminate familial variation. They were all about 100 days old and had already borne one litter thus establishing their fecundity. A diet sufficient in vitamins was supplied as it has been proved that a deficiency of vitamins can readily induce relative sterility. (6) The rats were kept warm, in clean cages and supplied a varied diet of milk green vegetables and table scraps. Long and Evans method of determining the presence of estral cycle was used (20).

When a female was found pregnant for the first time it was isolated until delivery of this initial litter and 10 days later at 4 day intervals was injected intramuscularly with 100,000, 200,000 and 300,000 spermatozoa. Two weeks after the last injection active young males were put into the cages with the sensitized females and allowed to stay there continuously. Vaginal scrapings of these female rats were examined at regular intervals for the presence of estral changes care

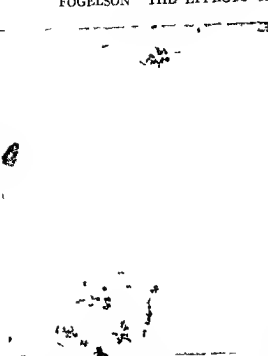


Fig 1 Photograph of agglutination of guinea pig spermatozoa by non specific sera X110

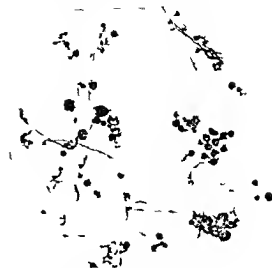


Fig 2 Large clump in Figure 1 shown in greater detail X230

reports the actual swelling and dissolution of sperm by blood sera of specific sensitized animals but in no case could this be demonstrated in these experiments for frequently after 24 hours suspension in hanging drops in specific sera spermatozoa would be found intact (Tables I II III)

#### EFFECT OF SENSITIZATION UPON GRAVID RATS

Pregnancy can be easily determined in rats by the absence of the normal cyclic changes in vaginal scrapings. In a series of 20 pregnant rats injection of 100 000 00 000 and 300 000 rat spermatozoa at 4 day intervals failed to have any effect upon pregnancy causing neither a decrease of the size resorption nor abortion of the litters. These negative results were obtained consistently and seem important in view of McCartney's opposite findings.

#### SEROLOGICAL RESULTS IN THE HUMAN

With these experimental facts as a foundation we next tried to demonstrate precipitins

agglutinins lysins or toxins in the sera and cervical secretions of 17 normal healthy married women with patent oviducts and no evident pelvic pathology to account for the sterility. The husbands could be eliminated as an etiological factor for they could qualify in all of Huhner's precepts. In no case could any evidence of protein sensitization be found to human spermatozoa protein suggesting that protein sensitization of the female in these so called idopathic sterilities is more fanciful than real.

#### DISCUSSION

From these results confirming the work of others it is evident that there is an accurate method of temporarily inhibiting conception by sensitization of the female rat to any spermatozoa protein. This antigenic effect of spermatozoa is not specific for species but equally good results can be obtained from the spermatozoa of any species. The mechanism causing this sterility is still not clear only precipitins being definitely present and their significance an unknown factor. The rôle of agglutinins can be considered negative, for as marked clumping can be seen in the sera of non sensitized animals especially after inactivation as in specific sera. Lysins were never seen and toxins which fixed or rendered

TABLE II—SENSITIZATION OF RATS TO  
GUINEA PIG SPERMATOZOA  
(Results in 10 of a series of 20)

N	Infant		Test Date	Rats	Interval between sensitized and test
	Dt	N			
1	6-10-24	7	6-12-24 6-15-24 6-19-24	Litter of 6 9-11-24	11 weeks
2	6-17-24	6	6-12-24 6-15-24 6-19-24	Litter of 6 9-1-24	6 weeks
3	6-22-24	7	6-20-24 7-1-24 7-4-24	Litter of 4 9-15-24	12 weeks
4	6-23-24	5	6-9-24 7-1-24 7-4-24	No preg.	10 weeks
5	7-3-24	5	7-12-24 7-16-24 7-19-24	Litter of 5 10-1-24	10 weeks
6	7-11-24	6	7-11-24 7-16-24 7-19-24	Litter of 5 11-4-24	14 weeks
7	9-5-24	4	9-15-24 9-19-24 9-21-24	Litter of 4 11-11-24	7 weeks
8	9-14-24		9-15-24 9-19-24 9-21-24	Litter of 6 12-20-24	8 weeks
9	10-24-24	8	11-11-24 11-15-24 11-20-24	Litter of 7 12-26-24	6 weeks
10	11-4-24	7	11-11-24 11-15-24 11-20-24	No preg.	9 weeks

Average of 10 rats of this series 14 weeks

TABLE III—SENSITIZATION OF RATS TO  
HUMAN SPERMATOZOA  
(Results in 10 of a series of 20)

N	Infant		Dates Injection	Rats	Interval between sensitized and test
	Dt	N			
1	6-10-24		6-12-24 6-15-24 6-19-24	Litter of 6 9-11-24	11 weeks
2	6-11-24	6	6-12-24 6-15-24 6-19-24	Litter of 6 8-1-24	6 weeks
3	6-22-24	7	6-20-24 7-1-24 7-4-24	Litter of 4 9-15-24	12 weeks
4	6-23-24	5	6-29-24 7-1-24 7-4-24	No preg.	10 weeks
5	7-3-24	5	7-12-24 7-16-24 7-19-24	Litter of 5 10-1-24	10 weeks
6	7-11-24	6	7-11-24 7-16-24 7-19-24	Litter of 5 11-4-24	14 weeks
7	9-5-24	4	9-15-24 9-19-24 9-21-24	Litter of 4 11-11-24	7 weeks
8	9-14-24	7	9-15-24 9-19-24 9-21-24	Litter of 6 11-0-24	8 weeks
9	10-24-24	8	11-11-24 11-15-24 11-20-24	Litter of 7 12-26-24	6 weeks
10	11-7-24	7	11-11-24 11-15-24 11-20-24	No preg.	10 weeks

Average of 20 rats of this series 14 weeks

that Meeker (22) reports the presence of agglutinins in the human and McCartney in rats in our experiments at no time would there be demonstrated more clumping in the specific sera than in non-specific controls, equally as marked clumping occurred with sera of men as with the specific sensitized sera. At no time were observed the classic agglutininations described by Lilhe (19), Loeb (21), and Sampson (27) for marine forms in which the spermatozoa are clumped from a homogeneous suspension by the addition of saltwater egg extract. A marked difference was observed in results obtained with fresh sera and inactivated sera. Spermatozoa were immobilized in fresh sera in 10 minutes while after inactivation the same sera allowed the sperm to remain motile for over hours. As

expected the more marked clumping occurred with inactivated sera in which the spermatozoa remained motile for a longer time. The fixation of the sperm could hardly be interpreted as due to toxins for it was as marked in the non-specific controls as in the specific sensitized sera. Bottner and Kirchheim (1) observed that in individuals who had had any foreign protein therapy and also in markedly cachectic individuals sperm remained motile for hours despite the fact that their sera had not been inactivated.

In these experiments at no time were lysins found in over 100 trials. No sera would cause the actual swelling and dissolution of spermatozoa in isotonic solution despite the fact that a definite precipitin for the specific sperm had already been demonstrated. Taylor (27)

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THE following case is of interest because it was encountered quite free from any previous gastrointestinal disturbances.

The family history was negative. For the past 12 years the patient has been a resident of Southern California, recently enrolled as a college student. During childhood he suffered a mild attack of measles and mumps no sequelæ. At the age of 5 years he suffered from earache for about 4 months subsiding without drainage. Although not subject to sore throat he had the tonsils removed at the age of 9. He weighed 140 pounds and during the past 6 weeks has gained 6 pounds. He gives a history of no other diseases or infections.

For 6 weeks immediately preceding his admission to the hospital patient had been attending the Reserve Officers Training Camp at Camp Lewis, Washington, and had enjoyed the best of health. During this time he led an active and strenuous life and was not fatigued. On the morning of June 26, 1924, he started from Camp Lewis to Los Angeles in a Ford, reaching San Francisco on the 27th at noon, having driven all day and all night. While on the journey he states that he hardly stopped for meals. About 12 p.m. June 27 he was awakened by a sudden cramplike pain of great severity in the umbilical and left hypochondriac region. He immediately experienced a feeling of nausea and vomited the food eaten at the previous meal. The pain continued in severity but was now confined to an area as large as his hand, around and over the umbilicus. During the next 3 or 4 hours this pain continued with occasional knife-like exacerbations without radiating. At the end of this time the pain seemed gradually to extend to the left costal margin, after a short interval it spread down the left flank into the lumbar and hypogastric regions. It remained unabated until the patient entered the hospital. There was no radiation of the pain to the genitalia, to the back or shoulder. There were no remissions.

Examination at the Emergency Hospital showed a young adult male, 21 years of age, suffering abdominal pain. There was slight flushing of the face. Patient quiet, perfectly oriented and answered questions readily but was in continuous pain.

General examination was negative except for the abdomen. Respiration 24, pulse 90, of good quality. The abdomen when first examined showed spasticity of the left abdominal muscles which in a short time spread to the entire abdomen. Light pressure in the left upper and left lower quadrants of the abdomen

was very painful but in the right lower quadrant tenderness was most marked. A rectal examination showed marked fullness in the pelvis with extruding pain from pressure on the pelvic peritoneum. The rectal temperature was 100 degrees F. The leucocyte count was 12,500 with 80 per cent polymorphonuclear and 15 per cent lymphocyte elements. The hæmoglobin was 80 per cent. Urinalysis showed the urine straw colored, acid, with specific gravity of 1.038, a slight cloud of albumin and an occasional granular cast in the sediment. The blood Wassermann report later came in negative.

**Diagnosis.** With these findings the diagnosis of an acute inflammation of the appendix was made, the appendix presumably pointing to the left along the base of the mesentery of the small bowel.

The patient was operated on under ether anesthesia 12 hours after the onset of the symptoms through a right rectus incision. On opening the peritoneum we found a small amount of serosanguinous fluid. The appendix almost immediately floated into view, the vessels were slightly engorged. It was evident that the appendix did not account for the patient's symptoms. On drawing the terminal ileum from the pelvis a quantity of fluid was released, serosanguinous in appearance, containing many blood-stained flakes of fibrin. Complete exploration of the small and large bowel failed to reveal pathology. A second incision was made through the upper right rectus and an examination of the stomach, duodenum and gall bladder gave negative findings. Through an opening in the gastrocolic omentum the pancreas was examined. The head, neck and body were normal in appearance and to palpation; in the region of the tail there was a mass the size of a mammoth walnut. The peritoneal surface in contact with this mass was edematous and blood-stained. One small area of a possible fat necrosis the size of a small grain of wheat was found in the greater omentum. This enlargement consisted of the tail of the pancreas which was chocolate color with the glandular markings indistinct and blurred. Inasmuch as the pathological changes were localized definitely to the tail of the pancreas, resection seemed the logical procedure. Great care was taken not to wound the splenic vessels which ran in a groove along the superior margin. The space left by the resection was drained by a cigarette drain coming out below the antrum of the stomach through the middle of the incision. Patient was returned to the ward in good condition. One half of the specimen was sent to the laboratory of the Surgical Division of the Stanford Service of the San Francisco Hospital, the other half was sent to the Department of Pathology of Stanford University.

spermatozoa immobile were such a variable factor that from these experiments no opinion is justifiable

### CONCLUSION

These results cast no light upon the etiology of so called 'idiopathic human sterility, they tend to eliminate protein sensitization as a causative factor. They do however, suggest possibilities of supplying a contraceptive technique with a definite scientific basis and upon this further research is now being attempted

I wish to express thanks to Dr L. Hektoen for his constructive criticism and demonstration of technique and to Dr Mark T. Goldfine from whose clinical material the human results were compiled

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THE following case is one we believe of interest because it was encountered quite free from any previous gastrointestinal disturbances

The family history was negative. For the past 12 years the patient has been a resident of Southern California, recently enrolled as a college student. During childhood he suffered a mild attack of measles and mumps, no sequelæ. At the age of 5 years he suffered from earache for about 4 months subsiding without drainage. Although not subject to sore throat, he had the tonsils removed at the age of 9. He weighed 140 pounds and during the past 6 weeks has gained 6 pounds. He gives a history of no other diseases or infections.

For 6 weeks immediately preceding his admission to the hospital, patient had been attending the Reserve Officers Training Camp at Camp Lewis, Washington, and had enjoyed the best of health. During this time he led an active and strenuous life and was not fatigued. On the morning of June 6, 1924, he started from Camp Lewis to Los Angeles in a Ford, reaching San Francisco on the 27th at noon, having driven all day and all night. While on the journey he states that he hardly stopped for a meal. About 11 p.m. June 27, he was awakened by a sudden cramplike pain of great severity in the umbilical and left hypochondriac region. He immediately experienced a feeling of nausea and vomited the food eaten at the previous meal. The pain continued in severity but was now confined to an area as large as his hand around and over the umbilicus. During the next 3 or 4 hours this pain continued with occasional knifelike exacerbations without radiating. At the end of this time the pain seemed gradually to extend to the left costal margin; after a short interval it spread down the left flank into the lumbar and hypogastric regions. It remained unabated until the patient entered the hospital. There was no radiation of the pain to the genitalia, to the back, or shoulder. There were no remissions.

Examination at the Emergency Hospital showed a young adult male, 21 years of age, suffering with abdominal pain. There was slight flushing of the face. Patient quiet, perfectly oriented, and answered questions readily, but was in continuous pain.

General examination was negative except for the abdomen. Respiration 24, pulse 90, of good quality. The abdomen when first examined showed spasticity of the left abdominal muscles which in a short time spread to the entire abdomen. Light pressure in the left upper and left lower quadrants of the abdomen

was very painful, but in the right lower quadrant tenderness was most marked. A rectal examination showed marked fullness in the pelvis with ever-crescentic pain from pressure on the pelvic peritoneum. The rectal temperature was 100 degrees F. The leucocyte count was 12,500 with 89 per cent polymorphonuclear and 11 per cent lymphocyte elements. The hæmoglobin was 80 per cent. Urinalysis showed the urine straw colored, acid, with specific gravity of 1.038, a slight cloud of albumin, and an occasional granular cast in the sediment. The blood Wassermann report later came in negative.

**Diagnosis.** With these findings the diagnosis of an acute inflammation of the appendix was made, the appendix presumably pointing to the left along the base of the mesentery of the small bowel.

The patient was operated on under ether anaesthesia 12 hours after the onset of the symptoms through a right rectus incision. On opening the peritoneum we found a small amount of serosanguinous fluid. The appendix almost immediately floated into view; the vessels were slightly engorged. It was evident that the appendix did not account for the patient's symptoms. On drawing the terminal ileum from the pelvis a quantity of fluid was released, serosanguinous in appearance, containing many blood-stained flakes of fibrin. Complete exploration of the small and large bowel failed to reveal pathology. A second incision was made through the upper right rectus and an examination of the stomach, duodenum, and gall bladder gave negative findings. Through an opening in the gastrocolic omentum the pancreas was examined. The head, neck, and body were normal in appearance and to palpation. In the region of the tail there was a mass the size of a mammoth walnut. The peritoneal surface in contact with this mass was edematous and blood-stained. One small area of a possible fat necrosis the size of a small grain of wheat was found in the greater omentum. This enlargement consisted of the tail of the pancreas which was chocolate color with the glandular markings indistinct and blurred. Inasmuch as the pathological changes were localized definitely to the tail of the pancreas, resection seemed the logical procedure. Great care was taken not to wound the splenic vessels which ran in a groove along the superior margin. The space left by the resection was drained by a cigarette drain coming out below the antrum of the stomach through the middle of the incision. Patient was returned to the ward in good condition. One half of the specimen was sent to the laboratory of the Surgical Division of the Stanford Service of the San Francisco Hospital; the other half was sent to the Department of Pathology of Stanford University.



Following is the report of W. Ophuls, Department of Pathology, Stanford University Medical School: Specimen consists of a portion of the pancreas which on the cut surface shows irregular chocolate brown areas alternating with areas of normal tissue.

Microscopically the sections show many lobules which are completely destroyed, others are partly necrotic surrounded by polymorphonuclear leucocytes. The interlobular spaces as well as many of the lobules contain many red blood cells as well as blood in various stages of decomposition. Some lobules are normal except for some hemorrhage extending between the alveoli. Several of the larger veins contain recent thrombi. Pancreatitis, acute hemorrhagic.

L. Eloesser of the Surgical Division of the Stanford Service of the San Francisco Hospital made the following report:

"Between all of the pancreatic acini almost uniformly distributed in thin and normal septa there lie recent hemorrhages but the cells of the acini themselves as well as the islands of Langerhans stain perfectly well and are not necrotic with the exception of a few minute areas at the very periphery where there are also intra acinary hemorrhages and an inflammatory exudate in a few acini. These are definitely necrotic. The vessels are engorged. The pancreatic ducts are empty. Diagnosis: early hemorrhagic pancreatitis.

The postoperative course of this case was uneventful. There was considerable drainage from the wound for several days of purulent material which contained no activated pancreatic ferments. Culture yielded a growth of hemolytic staphylococcus aureus.

In this case it is interesting to note the absence of premonitory symptoms and the absence of recognizable foci from which thrombi might have been carried to the pancreatic vessels. In 1912 Deaver and Pfeiffer discussed the etiology of acute pancreatitis and claimed that the disease was due to infection borne through the lymphatics. As the lymphatics run from the head of the gland to the tail, so infection more often commences at the head of the pancreas and extends into the tail. In the above case the tail of the pancreas showed marked pathology in which the remainder of

the gland did not share. The close relationship existing between acute pancreatitis and biliary disease has been recognized by many investigators and undoubtedly exists but in the case now presented no pathology of the biliary system existed.

The absence in this case of shock and cyanosis so frequently associated with acute hemorrhagic pancreatitis may be attributed to the small mass of the gland involved. The absence also of the typical fat necroses indicates that little if any of activated pancreatic juice was liberated into the peritoneal cavity. The symptoms more typically associated with acute hemorrhagic pancreatitis would in all probability have supervened had the operation been delayed.

Possibly small hemorrhages take place into the pancreas more often than we have any knowledge of causing gastric upsets that are explained on the basis of indiscretions in diet. When these hemorrhages take place in the head of the pancreas and there is pathology present in the bile passages a severe pancreatitis often results. If the hemorrhages are slight and in the body or tail of the pancreas it is our opinion that recovery without intervention often occurs. If the resistance is lowered by exposure, exhaustion or some debilitating illness plus focal infection bacteria will undoubtedly lodge in the hemorrhagic areas and produce just such a picture as we have described.

We firmly believe that slight hemorrhages into the pancreas are not uncommon. Whether the infection comes through the lymphatics or blood stream or is a retrograde infection coming through the pancreatic ducts, the resulting inflammation is similar except that the retrograde infection through the pancreatic duct is more extensive and activation of the ferments of the pancreatic secretion will cause more destruction.

# REGISTRY OF BONE SARCOMA

## PART I—TWENTY FIVE CRITERIA FOR ESTABLISHING THE DIAGNOSIS OF OSTEOGENIC SARCOMA

## PART II—THIRTEEN REGISTERED CASES OF FIVE YEAR CURES ANALYZED ACCORDING TO THESE CRITERIA

BY E A CODMAN M.D. F.A.C.S. BOSTON

### INTRODUCTION

ONE of the primary objects of the registry was to keep an up to date list of living cases which had had bone sarcoma and which could be considered as cured. It should be remembered that the Registry was started for and by the family of a patient under the care of the writer for a supposed bone sarcoma. They wished and I wished to ascertain the actual facts as to whether there were any living cured cases of this disease and if there actually were to ascertain the methods of treatment by which these patients had been cured. I was given a thousand dollars to pay my expenses in obtaining the required facts.

My first step (in August 1905) was to address a circular letter to the individual members of the American College of Surgeons and to the surgical profession in general. The advice of Dr. Ewing and Dr. Bloodgood was sought in consultation. Through the kindness of my personal friends in several earnest clinics follow up investigations were started. In fact that gift of a thousand dollars made me and many others work and soon led the Regents of the College to add an aggregate of \$8000 more contributed from time to time in order to answer these two simple questions. Now at the end of five years only 17 cases of primary malignant bone tumors have been collected which in our opinion may be considered cured (Ewing's tumor 4 cases—osteogenic sarcoma 13 cases).

In spite of all our efforts my patient died within the year and autopsy showed that the supposed sarcoma was a metastatic cancer of unknown origin. The chagrin of the error in diagnosis was somewhat allayed when reports from various clinics stimulated by our investigation began to appear. Greenough, Simmons, and Harmer analyzing the cases from the Massachusetts General Hospital and

Huntington Memorial Hospital for instance reported. Perhaps the most surprising fact of the whole study is that of 148 cases sent in as possible bone sarcoma only 68 could be considered in fact to be cases of malignant newgrowth of bony origin the remaining 82 cases proving on more detailed study to be metastatic tumors of bone (9 cases) sarcoma primary in the soft parts (28 cases) inflammatory conditions (11 cases), or tumors of a non sarcomatous type (14 cases).

It soon appeared that by products were to be the result of our industry rather than the intended product of obtaining the answers to our simple questions. The Registry itself was a by product for when our collection of cases could no longer be of possible benefit to my patient the Regents saw that the same questions would be eternal. The friends of future patients would always want to know of the living cases and how they were cured. Five years have passed since the first circular letter went out and some of our by products may be listed as follows:

1 Many contributions to the medical literature on bone tumors.

2 A more or less acceptable standard classification presented and discussed in the form of a small book. (Reprinted in Bull. Am. Col. of Surg. 1906, x No. 1 A.)

3 The impersonal proof of Dr. Bloodgood's contention that giant cell tumor is benign.

4 The impersonal proof that cases of giant cell tumor may be cured by radiotherapy.

5 The diffusion of Dr. Mallory's contention that benign giant cell tumor is not a neoplasm but a faulty repair phenomenon.

6 The impersonal proof that many of the cures from combined treatment by surgery, mixed toxins and radium claimed by Dr. Coffey are authentic.

7 The principle of co operative education (concerning rare diseases) among laboratories (the founding of other Registries)

8 The possession by the American College of Surgeons of collections of data on 100 standard benign giant cell tumors 100 standard osteogenic sarcomata of the femur, 100 standard osteogenic sarcomata of other bones 50 standard cases of Ewing's tumor (These data are neatly packed in trunk like boxes available for study by investigators or by pathologists or surgeons who see few bone tumor cases but who occasionally must decide questions of life and limb)

9 A principle suggested for the new Museum of the College (and for other museums) of accumulation of data on accepted standard clinical entities in available form for intensive research and educational study

10 The idea that the Museum might become a sort of patent office of new clinical entities. A practical example of this idea by submitting a collection of over 50 cases of Ewing's tumor

11 The suggestion that the College should devote its energies to the standardization of series of surgical cases asking from hospitals duplicate record of one series after another (For instance a check on the standardization of hospitals might be made in epitome on the manner in which the cases of bone sarcoma are registered since such registration tests not only the apparatus of roentgenologist pathologist and surgeon but the education, preparation and practical efficiency of the staff and perhaps even their consciences)

There are other by products but the true product of our industry is small—only 17 cases of 5 year cures of primary malignant tumors of bone on which the Committee can agree tentatively. And in these cases much essential evidence is lacking. In ten of the five for instance the X ray has been lost. The evidence on few of the 17 is entirely convincing.

As to the treatment all but 1 of the 17 had amputation and that one had a local exploration followed by intensive radium treatment and mixed toxins. Nine of the other 16 also had toxins. Eight also had radiation. In 8

cases these treatments were combined. Seven had no other treatment than amputation so far as is known.

I think the average surgeon will perhaps be content with the two paragraphs above. He will continue to amputate in doubtful cases if he thinks there is any possible chance that no metastases have already occurred. He will ignore the fact that the one radium and toxin cure probably represents a greater percentage of cures among those where this combination of treatments has been attempted than the sixteen amputations represent to the vast number in which surgery has failed.

We have many unknown factors. (1) How many amputations have been done and failed? (2) How many cases have there been in which the mixed toxins have been thoroughly tried and failed with or without amputation? (3) How many cases have received thorough radiation with or without surgery?

We have few facts and can estimate as we please. The answers are probably (1) Very very many (2) A good many (3) Very few or even very very few. And all this guess work must take into consideration that of all the cases submitted to the Registry as sarcomata the Committee believes only a little over 50 per cent were actually malignant primary tumors of bone!

Since the Registry was not quite 5 years old at the time this set of 17 cases was agreed on by the Committee (June 1, 1915) the real use of the collection in answering our question will not be attained for 5 years from that date. It can then deal with cases of standard diagnoses agreed on before the result is known. At present we can only say that it is probable that an occasional case may be saved by amputation or by amputation combined with toxins and radium, and that in 1 atypical case of primary malignant bone tumor with metastases in the groin the patient recovered after an exploratory operation and the postoperative use of Coley toxins and radium.

Will the reader please reconsider the last sentence and bear in mind that these statements were made by the Registrar of a Committee of the largest surgical society in the world consisting of over 7000 members every one of whom has been repeatedly solicited

ted to register any case of bone sarcoma in which the patient is living whether cured, under treatment or moribund and especially if cured 5 years ago<sup>1</sup>

And yet anyone in searching the literature will find many reports of cures and percentages of cures. Read again the above quotation from Greenough Simmons and Harmer and reflect on the percentage of erroneous diagnoses compared with the percentage of cures.

However the paragraph in italics does not give all our optimism for it is boiled down to the coldest hardest facts. We have other evidence that all of these therapeutic agents amputation, Coley toxins and radium are effective in greater or less degree. There are a few more cases remaining well 5 years which we *almost* accept. There are many 5 year cures in cases which we consider benign giant cell tumor and a considerable number of cases of osteogenic sarcoma are nearing the 5 year limit. We are confident that each year in the future the report of the Registrar will be more favorable—particularly in regard to the use of radiation.

The Committee of which I was Registrar will be abundantly satisfied if they have succeeded in establishing a moderately acceptable standard nomenclature and moderately acceptable criteria of malignancy. To recommend an absolute nomenclature or absolute criteria would be ridiculous. Nevertheless nomenclature and criteria must precede statistics on therapeutics.

# PART I—TWENTY FIVE CRITERIA FOR ESTABLISHING THE DIAGNOSIS OF OSTEOGENIC SARCOMA

Our list of 17 cured cases applies only to primary malignant tumors of bone that is to our classes of osteogenic sarcoma (13) and of Ewing's tumor (4). Of the latter I shall say little because there is at this writing an article in press for the *Archives of Surgery* by C. L. Conner which analyzes all our cases of Ewing's tumor and really gives the most up-to-date knowledge of this new entity. The four 5 year cures of Ewing's tumor No 185 No 267 No 348 No 398 will there be reported. They will also be reported from the Memorial Hospital Clinic of New York by Coley and

some have already appeared in the literature in Ewing's articles. As will appear in Conner's critical analysis Ewing's tumor is in a class by itself as far as prognosis under radiation is concerned. It was thus favorable response to radiation which first led Ewing to see that it was a separate entity apart from true osteogenic sarcoma.

Before speaking individually of the 13 remaining cases of supposed 5 year cures let us consider the criteria of malignancy in osteogenic sarcoma. Out and out cases of malignant osteogenic sarcoma will show every one of these points although occasionally one or two may be doubtful absent or impossible to verify (Table I).

## HISTORY

Nearly all histories of osteogenic sarcoma cases conform to the following five points.

1 *Onset* The onset is with pain before tumor is noticed or pathological fracture occurs. The patient may not consult his physician until the tumor appears but in that case careful questioning will bring out the history of previous pain, perhaps intermittent in character. History of preceding trauma is frequent but always open to the question of whether the trauma caused the lesion or only called attention to it. Pathological fracture is common as the first symptom in carcinomatous metastases or in benign central lesions as cysts and giant cell tumors but so rare as to be merely the exception which makes the rule in osteogenic sarcoma. Late in the disease it is not very uncommon. *If we say therefore that unless pain precedes other symptoms we may suspect that the case is not one of osteogenic sarcoma.*

2 *Duration* We rarely get a history of years. Not infrequently the symptoms have existed about a year before the patient seriously seeks medical advice but it is very rare that a patient allows 2 years to elapse. On the other hand it is very unusual for a patient to seek advice before at least a month has elapsed. The pain is usually bearable at first. The earliest case which we know of had had pain for a little less than a month. In benign osteogenic tumors the history is usually of years.

TABLE I

Clinical	Hb	Rd	Well	Blood good and Col y	Blood good	Blood good	Col y	Col y	Thromb	Col y	Blood good	Col y	Clay
Cause of morbidity	0	3	64	00	0	0	17	154	6	43	101	156	31
History													
1 Onset with pain—diffuse	0	0	+	+	0	0	+	0	+	+		0	+
2 Duration—N.Y. weeks but months	0	0	+	+	+	+	+	+	+	+		0	+
3 General debility—loss of strength	+	+	+	+	+	+	+	+	+	+		0	+
4 Age—N.Y. unless Paget	+	+	+	+	+	+	+	+	+	+		0	+
5 Rapid growth—month by month	+	0	+	+	+	+	+	+	+	+		0	+
Examination													
Immaturity—soft perit	+	0	+	+	+		+	+	+	+		+	+
Location—tumor	+	+	+	+	+	+	+	+	+	+		0	+
3 Nodular—irregular	+	+	0	+	0	+	+	+	+	+		+	0
4 Intact—fixed	+	+	+	+	0		+		+	+		+	+
5 Shallow—deep (tumor calcified)	+	+	+	+	+	+	+	+	+	+		+	+
Notes													
1 Both ends of bone lost—no tibia				+			+					+	+
Old shaft present—not padded				+			+					0	+
3 Iva—no osseous deposit				+			+					+	+
4 Osteolytic deposit—tumor				+			+					+	+
5 Soft parts—no tumor				+			0					+	+
Miscellaneous													
Microscopic (hyperchromatic)	+	+	+	+	+	+	+	0	+	+	+	+	+
Plasmorphism	+	+	+	+	+	+	+	+	+	+	+	+	+
3 Tumor giant cells	+	+	+	+	0	+	+	+	+	+	+	+	+
4 Difficult to handle	+	+	+	0	+	+	+	0	+	+	+	+	+
5 Tumor vessel	+	+		+	+	+	+	+	+	+	+	+	+
Conclusions													
1 Not spontaneous—metastatic	+	0	0	+	+	0	+	+	+	0	0	+	0
2 Quilting—tumor	0	0	+	+	0	0	+	0	+	+	0	+	+
3 Unilateral—pelvic	+	+	+	+	0	+	+	0	+	0	0	+	+
4 Therapeutic classification	+	+	+	+	+	+	+	+	+	+	+	+	+
5 Therapeutic result	0	0	0	0	0	0	0	0	0	0	0	0	0

Therefore if the patient sought advice in less than a month or over a year from the onset of symptoms we may suspect that the case is not one of osteogenic sarcoma.

3 The general condition. Apparently bone sarcoma does not arise in the unhealthy except after 50 in cases of Paget's disease of the skeleton. If the patient was in poor health at the onset the probabilities favor the tumor being inflammatory—tuberculosis syphilis osteitis etc. Bone sarcoma seems to be a disease of the healthy whose repair processes may be exuberant. This statement is not at variance with the belief of Ewing expressed to me in conversa-

tion that persons who develop bone sarcoma may have some essential defect in their mechanism for tissue repair. I believe myself that these patients repair to death as persons with hæmophilia bleed to death. That is that the mechanism which should check repair is absent or diminished just as in persons with hæmophilia the clotting mechanism is abnormal. However these sarcoma patients almost invariably appear to be in good health.

Therefore unless the patient is considered in good health just before onset we may suspect the case is not one of osteogenic sarcoma.

4 *Age* With the exception of cases which also have Paget's disease 12 in number we have no instances of osteogenic sarcoma in a patient over 50. Paget's disease rarely occurs before 50. As recently computed by Bird and Sosman the incidence of osteogenic sarcoma in Paget's disease is 12 to 14 per cent (personal communication). In the recent Survey of bone sarcoma cases in Massachusetts the writer concluded that the incidence of bone sarcoma is about 1 to 100,000 in the population at one time.

*Therefore in any patient over 50 who does not have coincident Paget's disease we may suspect the case is not one of osteogenic sarcoma.*

5 *Rapidity of growth* Benign osteogenic tumors (N.B. this does not mean benign giant cell tumor) may be exceedingly slow in growth; the change not even being noticeable from year to year, they may however have periods of increase of growth but this is seldom rapid enough to be noticeable month by month—rather year by year. Inflammatory conditions often noticeably enlarge day by day and very often week by week. Osteogenic sarcomata as a rule show steady enlargement practically always noticeable in a month.

*Therefore we may suspect that a case is not one of osteogenic sarcoma if the enlargement has been noticeable day by day or week by week or has not been noticeable month by month.* This statement of course excludes cases subjected to the modern therapeutic test of radiation.

#### EXAMINATION

Cases of osteogenic sarcoma nearly always conform to the following five points in examination.

1 *Immobility of soft parts* Of course this is a difficult point to determine but one in which experience readily teaches. Rarely does an osteogenic sarcoma permit one to feel the soft tissues roll over the bone as does a giant cell tumor or cyst. This point is reversed in the inflammatory conditions which when they have perforated the bone may cause as much or more fixation of the soft parts than osteogenic sarcoma. Under the microscope there is a marked increase of large vessels in the periphery about an osteogenic sarcoma. There are often huge dilated superficial veins. I be-

lieve this peculiar fixation of the soft parts may be due to the ramifications of these new vessels.

*Therefore we may suspect that a case is not one of osteogenic sarcoma if there is clearly mobility of the soft parts over the tumor.*

2 *Location* Approximately one half of all osteogenic sarcomata occur in the femur, one quarter in the tibia, one half of the remainder in the other long bones. Of the other bones in the skeleton the phalanges of fingers and toes, the carpal and most of the smaller tarsal bones appear to be exempt. Osteogenic sarcoma is rare in the shaft of a long bone but this situation is the customary one for Ewing's tumor or for carcinomatous metastases and myeloma.

*Therefore the situation of a tumor may make us suspect that it is not an osteogenic sarcoma if it is not in one of the known usual sites and the suspicion is in inverse proportion to the frequency of occurrence at its site.*

3 *Inflammatory signs* In exceptional cases the usual signs of inflammation may occur in osteogenic sarcoma; they are not at all unusual in cases of Ewing's tumor. Radiation may temporarily produce them. However the typical osteogenic sarcoma does not present especially in its early stages pronounced fever, tenderness, redness, leucocytosis, etc. Nevertheless these cases are usually mistaken for osteomyelitis.

*Therefore unless the signs of inflammation are absent or very mild we may suspect that the case is not one of osteogenic sarcoma.*

4 *Condition of neighboring joints* The dissection of specimens of osteogenic sarcoma shows that it rarely invades the neighboring joints until late in the course of the disease or unless as a sequence to fracture or operation. Joint cartilage seems to act as a barrier to both benign giant cell tumor and osteogenic sarcoma. The latter almost invariably proceeds actually to the cartilage while the former often leaves a considerable amount of spongy bone between it and the cartilage. The presence of an osteogenic sarcoma near a joint does not involve the motion of the joint except in proportion to the fixation of the soft parts. Such limitation as there is is not due to spasm as is the case in inflammatory conditions of the

joint or peri articular structures (unless there is fracture also)

*Therefore in a case in which there is not a considerable degree of free motion in the adjacent joints we may suspect that the tumor is not an osteogenic sarcoma*

5 *Site and shape* No early sarcoma of small size nor of distinctly pedunculated shape has yet been registered. The facts that they are usually well developed when first noticed that they usually surround the bone or most of its circumference, that they are as a rule both intracortical and extracortical, that they grossly resemble callus make the writer feel that it is almost absurd to suppose that they start in small areas and then spread. They can better be understood as starting in a region as callus does than in small groups of cells. If the latter why should they grow through the strong cortex to the other side no matter which side they start on? At any rate thus far all gross specimens show tumors of considerable size which are both medullary and subperiosteal with the old cortex more or less firmly in its old place. Pedunculated bone tumors are nearly always benign except when congenital exostoses have been excited by trauma to efforts at repair.

*Therefore if a tumor is not of considerable size or if it is pedunculated we may suspect it is not an osteogenic sarcoma*

#### THE X RAY

The X ray also furnishes us with five pretty constant criteria

1 *Combined central and subperiosteal involvement* Good roentgenographic pictures of osteogenic sarcomata demonstrate this point almost as well as sagittal gross sections. One must bear in mind however that superimposed bone outside the cortex may make the medullary shadow irregular in density. The little cuff of reactive bone of trumpet shape which surrounds the upper limit of the tumor appears in the X ray as a triangular space on each side of the shaft under the uplified periosteal edge. The presence of this is a sure indication of subperiosteal extracortical involvement. It represents the last line of defense of normal osteoblasts retreating in circular formation as the tumor advances under

the periosteum. Unfortunately, the same phenomenon sometimes occurs as a defense against inflammation so that this reactive triangle in itself is not diagnostic of sarcoma. Benign tumors are either inside or outside the old cortex. Malignant are both.

*If we may therefore suspect that it is not a case of osteogenic sarcoma when the X ray does not show both medullary and subperiosteal involvement*

2 *Presence of old shaft* As stated above we rarely dissect a specimen of osteogenic sarcoma without finding the old shaft in its normal position—even if it is in fragments. It may be almost entirely destroyed in old tumors but even then the remaining fragments are seldom pushed much out of place. The contrary takes place in benign giant cell tumor which gives the appearance of distending the bone. In Ewing's tumor the cortex is usually widened by the thrust of the tumor cells between the lamellae and old bone may be carried somewhat to the periphery. In osteogenic sarcoma the perforation of the cortex seems to be as a rule transverse from within outward radially through the cortex or perhaps in the opposite direction. We have no clue as to whether they start inside or outside the cortex. If new bone forms it follows these radiating lines. One must think of these radiating line not as they show in the X ray as spicules but as they really are in the gross specimen as ridges or osteophytes of irregular form on the surface of the cortex.

*Therefore if the X ray does not show the old cortex or fragments of it in normal position we should suspect that the case is not one of osteogenic sarcoma*

3 *In its character* Dissection shows and so do our standard series of osteogenic sarcomata that the advancing edge of these tumors in the spongy bone is practically never rounded and smooth as is nearly always the case in giant cell tumors and some vascular carcinomatous metastases. Osteogenic sarcoma advances by invasion of the cells and the margin is irregular. Giant cell tumors and a few vascular metastases advance by pressure atrophy due to their pulsation as do aneurysms.

*Therefore a sharp outline of the tumor against spongy bone may make us suspect that we are not dealing with an osteogenic sarcoma*

4 *Osteolytic or osteoblastic or both* A typical X ray of a case of osteogenic sarcoma shows that the tumor is both osteolytic and osteoblastic. However in rare cases particularly if far advanced these tumors may be only osteolytic or only osteoblastic. If wholly osteolytic the suspicion of metastatic carcinoma is aroused and if wholly osteoblastic of a benign osteogenic tumor. In most cases characteristic radiating spicules are shown and form a very positive sign although exceptionally metastases or inflammation may produce them. The frequency of this sign of spicule formation is not enough to form a rule and the absence of it is not very strong evidence against osteogenic sarcoma.

Therefore unless the X ray shows that the tumor is both osteolytic and osteoblastic or if it shows that it is wholly one or the other suspicion that it is not a case of osteogenic sarcoma is aroused.

5 *Involvement of soft parts* This is a difficult point on which to interpret the X ray. Giant cell tumors which have burst their capsule have frequently been interpreted as having the soft parts involved and yet dissection in such cases has never shown this form of tumor as actually invading the soft parts although it may push them aside on fascial planes. Vice versa the X ray of an osteogenic sarcoma may lead us to think it has not involved the soft parts and dissection will show that it has. If we define the 'soft parts' as including the extracortical space between the raised periosteum and the bone as shown by the reactive triangle above alluded to at its upper limit we may get much help. Dissection shows that when we find this condition the tumor is always at least subperiosteal and usually has also broken through the periosteum and begun to invade the soft parts.

Therefore we may say that a tumor which does not show in the X ray either invasion of the soft parts or the reactive triangle is perhaps not an osteogenic sarcoma.

#### MICROSCOPIC CRITERIA

The microscope gives also a pretty definite criteria common to most osteogenic sarcomata.

1 *Mitoses and hyperchromatism* The relative frequency of mitotic figures has long been

a guide in estimating malignancy in all tumors. Rapid growth in most tissues is characterized by a relatively large number of mitoses. Like other criteria this one has its exceptions for numerous mitoses may occur for instance in fungating granulation tissue and also in certain benign tumors. In benign giant cell tumor for instance they are often quite numerous and if an operation has been done and the wound is fungating they are usually very numerous. On the other hand excess of mitotic figures is a very constant finding in typical osteogenic sarcoma. Hyperchromatism of nuclei is a parallel phenomenon probably equivalent to mitotic activity or at least indicative of it. Sometimes it is seen without it and yet it indicates it.

Therefore the finding of numerous mitoses in a bone tumor does not necessarily indicate osteogenic sarcoma but absence or infrequency of mitotic figures should arouse the suspicion that the case is not one of osteogenic sarcoma.

2 *Pleomorphism* All our instances of osteogenic sarcoma which have run a malignant course showed this criterion constantly. The degree of pleomorphism is of course a matter of individual judgment. There is a normal range of variations of size and shape in normal cells which it requires experience to recognize. In some cells the range is great for instance the endothelial leucocyte is protean in its ability to change in shape and size. In general a bone tumor must be considered within normal limits of pleomorphism if no cells are found which cannot be duplicated in normal inflammation. This is the rule in benign giant cell tumors for none of the 100 standard tumors of this kind in the Registry series contain even small numbers of distinctly atypical cells. On the other hand our series of osteogenic sarcomata all do. Ewing's tumors are not pleomorphic and yet are very malignant.

Probably the best single way in which to grade osteogenic sarcomata would be to base the prognosis on the degree of pleomorphism. This is equivalent to expert histologic opinion, for any good histologist probably bases his opinion of the prognosis in any malignant tumor largely on its pleomorphism although he takes account of the other factors as mitotic activity, hyperchromatism



joint or peri articular structures (unless there is fracture also)

*Therefore in a case in which there is not a considerable degree of free motion in the adjacent joints we may suspect that the tumor is not an osteogenic sarcoma*

**5 Size and shape** No early sarcoma of small size nor of distinctly pedunculated shape has yet been registered. The facts that they are usually well developed when first noticed that they usually surround the bone or most of its circumference that they are as a rule both intracortical and extracortical that they grossly resemble callus make the writer feel that it is almost absurd to suppose that they start in small areas and then spread. They can better be understood as starting in a region as callus does than in small groups of cells. If the latter why should they grow through the strong cortex to the other side no matter which side they start on? At any rate thus far all gross specimens show tumors of considerable size which are both medullary and subperiosteal with the old cortex more or less firmly in its old place. Pedunculated bone tumors are nearly always benign except when congenital exostoses have been excited by trauma to efforts at repair.

*Therefore if a tumor is not of considerable size or if it is pedunculated we may suspect it is not an osteogenic sarcoma*

#### THE X RAY

The X ray also furnishes us with five pretty constant criteria

**1 Combined central and subperiosteal involvement** Good roentgenographic pictures of osteogenic sarcomata demonstrate this point almost as well as sagittal gross sections. One must bear in mind however that superimposed bone outside the cortex may make the medullary shadow irregular in density. The little cuff of reactive bone of trumpet shape which surrounds the upper limit of the tumor appears in the X ray as a triangular space on each side of the shaft under the uplifted periosteal edge. The presence of this is a sure indication of subperiosteal extracortical involvement. It represents the last line of defense of normal osteoblasts retreating in circular formation as the tumor advances under

the periosteum. Unfortunately, the same phenomenon sometimes occurs as a defense against inflammation so that this reactive triangle in itself is not diagnostic of sarcoma. Benign tumors are either inside or outside the old cortex. Malignant are both.

*If we may therefore suspect that it is not a case of osteogenic sarcoma when the X ray does not show both medullary and subperiosteal involvement*

**2 Presence of old shaft** As stated above we rarely dissect a specimen of osteogenic sarcoma without finding the old shaft in its normal position—even if it is in fragments. It may be almost entirely destroyed in old tumors but even then the remaining fragments are seldom pushed much out of place. The contrary takes place in benign giant cell tumor which gives the appearance of distending the bone. In Ewing's tumor the cortex is usually widened by the thrust of the tumor cells between the lamellae, and old bone may be carried somewhat to the periphery. In osteogenic sarcoma the perforation of the cortex seems to be as a rule transverse from within outward radially through the cortex or perhaps in the opposite direction. We have no clue as to whether they start inside or outside the cortex. If new bone forms it follows these radiating lines. One must think of these radiating lines not as they show in the X ray as spicules but as they really are in the gross specimen as ridges or osteophytes of irregular form on the surface of the cortex.

*Therefore if the X ray does not show the old cortex or fragments of it in normal position we should suspect that the case is not one of osteogenic sarcoma*

**3 Invasive character** Dissection shows and so do our standard series of osteogenic sarcomata that the advancing edge of these tumors in the spongy bone is practically never rounded and smooth as is nearly always the case in giant cell tumors and some vascular carcinomatous metastases. Osteogenic sarcoma advances by invasion of the cells and the margin is irregular. Giant cell tumors and a few vascular metastases advance by pressure atrophy due to their pulsation as do aneurysms.

*Therefore a sharp outline of the tumor against spongy bone may make us suspect that we are not dealing with an osteogenic sarcoma*

4 *Osteolytic or osteoblastic or both* A typical X ray of a case of osteogenic sarcoma shows that the tumor is both osteolytic and osteoblastic. However in rare cases particularly if far advanced these tumors may be only osteolytic or only osteoblastic. If wholly osteolytic the suspicion of metastatic carcinoma is aroused and if wholly osteoblastic of a benign osteogenic tumor. In most cases characteristic radiating spicules are shown and form a very positive sign although exceptionally metastases or inflammation may produce them. The frequency of this sign of spicule formation is not enough to form a rule and the absence of it is not very strong evidence against osteogenic sarcoma.

*Therefore unless the X ray shows that the tumor is both osteolytic and osteoblastic or if it shows that it is wholly one or the other suspicion that it is not a case of osteogenic sarcoma is aroused.*

5 *Involvement of soft parts* This is a difficult point on which to interpret the X ray. Giant cell tumors which have burst their capsule have frequently been interpreted as having the soft parts involved and yet dissection in such cases has never shown this form of tumor as actually invading the soft parts although it may push them aside on fascial planes. Vice versa the X ray of an osteogenic sarcoma may lead us to think it has not involved the soft parts and dissection will show that it has. If we define the soft parts as including the extracortical space between the raised periosteum and the bone as shown by the reactive triangle above alluded to at its upper limit we may get much help. Dissection shows that when we find this condition the tumor is always at least subperiosteal and usually has also broken through the periosteum and begun to invade the soft parts.

*Therefore we may say that a tumor which does not show in the X ray either invasion of the soft parts or the reactive triangle is perhaps not an osteogenic sarcoma.*

#### MICROSCOPIC CRITERIA

The microscope gives also a pretty definite criteria common to most osteogenic sarcomata.

1 *Mitoses and hyperchromatism* The relative frequency of mitotic figures has long been

a guide in estimating malignancy in all tumors. Rapid growth in most tissues is characterized by a relatively large number of mitoses. Like other criteria this one has its exceptions for numerous mitoses may occur for instance in fungating granulation tissue and also in certain benign tumors. In benign giant cell tumor for instance they are often quite numerous and if an operation has been done and the wound is fungating they are usually very numerous. On the other hand excess of mitotic figures is a very constant finding in typical osteogenic sarcoma. Hyperchromatism of nuclei is a parallel phenomenon probably equivalent to mitotic activity or at least indicative of it. Sometimes it is seen without it and yet it indicates it.

*Therefore the finding of numerous mitoses in a bone tumor does not necessarily indicate osteogenic sarcoma but absence or infrequency of mitotic figures should arouse the suspicion that the case is not one of osteogenic sarcoma.*

2 *Pleomorphism* All our instances of osteogenic sarcoma which have run a malignant course showed this criterion constantly. The degree of pleomorphism is of course a matter of individual judgment. There is a normal range of variations of size and shape in normal cells which it requires experience to recognize. In some cells the range is great, for instance the endothelial leucocyte is protean in its ability to change in shape and size. In general a bone tumor must be considered within normal limits of pleomorphism if no cells are found which cannot be duplicated in normal inflammation. This is the rule in benign giant cell tumors for none of the 200 standard tumors of this kind in the Registry series contain even small numbers of distinctly atypical cells. On the other hand our series of osteogenic sarcomata all do. Ewing's tumors are not pleomorphic and yet are very malignant.

Probably the best single way in which to grade osteogenic sarcomata would be to base the prognosis on the degree of pleomorphism. This is equivalent to expert histologic opinion for any good histologist probably bases his opinion of the prognosis in any malignant tumor largely on its pleomorphism although he takes account of the other factors as mitotic activity, hyperchromatism

and the arrangement of chromatin nucleus and nucleolus. However it does not yet appear necessary to attempt to grade osteogenic sarcoma, for our collection is not yet large enough and as yet we cannot say bad worse, worst. To say Bad is enough for after 5 years search we find only 13 cures.

*Therefore any bone tumor which does not show pleomorphism is probably not an osteogenic sarcoma*

**3 Tumor giant cells.** It is not difficult to demonstrate to a student the difference between typical tumor giant cells and foreign body giant cells. However occasional doubtful giant cells are found but very rarely are all the giant cells in a single slide doubtful. A few individual giant cells or small areas of foreign body giant cells are of frequent occurrence in osteogenic sarcomata and have little significance in diagnosis as they probably merely indicate hemorrhage in the tumor. On the other hand one may confidently expect a tumor to be malignant if it contains tumor giant cells but not necessarily to be a primary bone tumor. Tumor giant cells may occur in cancer also but we seldom see them in bone metastases. Then too many osteogenic sarcomata show no tumor giant cells.

*This criterion therefore is not universal but we may say that its presence in an osteogenic tumor is a very reliable sign of malignancy but its absence need not make one suspicious either of the malignancy of the tumor or of its place in the osteogenic series.*

**4 Differentiation.** It has proved impossible to make the differentiation toward intercellular substances as (fibro chondro osteo) criteria of malignancy. There is an endless variety of proportions of these intercellular substances and an imperceptible series of gradations from one intercellular substance to another. At most differentiation can only be used as a criterion of degree the less the differentiation in other words the more cellular the tumor the more malignant. And now that radiation has been shown to be effective in the inverse way it is still harder to use this factor as a criterion. For instance Ewing's tumor which may be simply an undifferentiated form of osteogenic sarcoma has now a days with radiation a better prognosis than a

relatively well differentiated osteogenic sarcoma of the chondro type. Yet the relative proportion of cellular tissue in chondromatous tumors is very important in their prognosis for the greater it is the worse the prognosis.

*Therefore in an osteogenic tumor very complete differentiation or almost no differentiation is better than incomplete differentiation and the evidence of quite complete differentiation should make us suspect that the case is not an osteogenic sarcoma but a benign osteogenic tumor.*

**5 Tumor vessels (vascular arrangement).** As this criterion is my own hobby I hesitate to present it but as I have found it very reliable even if new I offer it for it may help other. Early in the Registry work I noticed that the malignant tumors had a different vascular arrangement from the benign giant cell tumors. The latter have only capillaries or sinuses without any walls except the endothelium lining them. As a contrast to this all malignant tumors have definite branching vessels with walls of varying thickness largely composed of tumor cells. In other words these tumors have a perithelial arrangement as a constant factor and the vessels branch like the limbs or twigs on a tree. The tumor cells hang on them like swarms of bees whether the cells have no intercellular substance as in Ewing's tumors or well developed cartilaginous material as in some chondrosarcomata. One may see an endothelial lining or perhaps a lining of tumor cells and immediately adjacent perithelial arrangements of cartilage cells. Great variety of appearance of these tumor vessels is a characteristic also.

*I find these tumor vessels a constant factor. They are certainly useful in distinguishing giant cell tumors from the osteogenic tumors benign and malignant. As a criterion to differentiate malignant from benign osteogenic tumors or callus it again becomes a question of the individual cells forming the walls. Benign osteogenic tumors do not have pleomorphic cells in the vessel walls. I made one error in considering exuberant callus malignant on account of somewhat atypical vessels.*

*My personal conviction is that every osteogenic sarcoma shows tumor vessels and that a tumor which does not show them in several sections is not an osteogenic sarcoma.*

Experienced pathologists have of course noticed these vessels as the vascular arrangement of tumors in general, but so far as I know they have not contrasted this vascular arrangement with the interstitial blood supply of giant cell tumors. Perhaps vascular arrangement is a better heading than tumor vessels which I have used hitherto.

# GENERAL CRITERIA

There are five general criteria of malignancy in a bone tumor which seem to me important:

1. *The nature of the pathological examination.* For instance the most expert pathologist will not be able to give us as much help on the stingy bit of dried tissue handed him by some uninterested operator as can a keen surgeon in an out of the way clinic who has made a complete and careful examination and description of the amputated limb. Opinion based on careful examination of the dissected gross specimen by a competent pathologist or by a good surgical observer is very strong evidence for osteogenic sarcoma. Yet it is by no means absolute.

We have two gross specimens in the Registry Collection which have not yet been satisfactorily classified. For example Case 187 which is claimed as a cured case of osteogenic sarcoma by Ewing and Coley. I have not included in the present list although Dr. Ewing examined the gross specimen and still possesses it. From the situation of the tumor in the lower end of the radius and from Dr. Ewing's own description I suspect it to be a variant of giant cell tumor.

Nevertheless we may say that if the diagnosis is confirmed by competent examination of the gross specimen it is one of the strongest but not an absolute criterion. If other important criteria do not agree the suspicion is aroused that the tumor is not an osteogenic sarcoma. Furthermore histological reports even by excellent pathologists on small and imperfect exploratory specimens should not be accepted unless in agreement with other important criteria.

2. *The quality of the data.* What has been said in regard to the character of the pathological data applies to the other data. A history taken by someone interested in the patient or in the bone sarcoma problem is

likely to be much more fruitful than if carelessly taken by someone interested in neither. Our best histories have come from either the small hospitals where the patient is of paramount interest or from the occasional man in some large clinic who is interested in bone tumors.

3. *The character of the roentgen data is of great importance.* There is a deplorable tendency to neglect technique in bone cases. The greatest possible detail is needed and if attained may be of more importance to the patient than the surgeon's knife. Undoubtedly we must look to the roentgenologist to find the criteria of diagnosis at the early stage when pain has begun and tumor has not yet appeared.

*If we may say then that the quality of the data has much to do with our conviction of the diagnosis of osteogenic sarcoma.*

3. *Unanimity of the different specialists.* In typical instances of osteogenic sarcoma the clinician, the roentgenologist, the operator, and the pathologist all arrive independently at the same diagnosis. As our experience progresses and knowledge diffuses this rule becomes more striking.

A patient entering a hospital which has co-operated in the work of the Registry will probably have his bone tumor independently diagnosed by the different departments. If one has doubt all should have and probably actually have. General agreement however will be the rule.

*To express this differently any hospital which is doing its best for cases of bone tumor will promptly diagnose the majority of cases of osteogenic sarcoma independently in each department concerned and the synthesis of these opinions and the action to be taken on them will be the responsibility of someone familiar with the work of the Registry.*

4. *The Registry classification.* A criterion of more or less value in regard to the diagnosis of a case of osteogenic sarcoma is whether or not it has been so accepted by the Registry Committee. This is neither final nor fundamental and merely represents the best obtainable collection of opinions on such data as is furnished at a given date. Any hunter knows the difficulty of distinguishing game

running through the woods. An idea of the height of the animal is obtained at one glance the flash of a white tail at another, and the outline of horns at a third. The conviction that a deer has passed may be arrived at but the story the hunter tells will be believed in proportion to his own experience and standing, in intellectual honesty. At that he may be mistaken.

*Expert opinion would not be expert opinion if as a rule it were capable of proof. The relative importance of the criterion of the Registry Classification is of this degree and varies with the character of the data and of the Committee.*

The entity of osteogenic sarcoma has been recognized by a group as hunters recognize a rare animal by repeated glimpses in all degrees of perfection, from a flash through the woods to the slaughtered dissected stuffed macerated dried bottled or serially sectioned in individual. One hunter who might recognize the forest vertebrae of the animal might not recognize the living creature darting through the woods. The practical hunter would although he might confuse it with one of an allied species. The Registry Committee has had the advantage of being aided by much expert help and by varied points of view from different individuals. It has succeeded in establishing this entity and describing its characteristics but in individual cases it may be mistaken on fleeting glimpses. The 13 cases here submitted are of this character. It is our belief that they were instances of osteogenic sarcoma but we ourselves recognize the possibility of error.

In our series of 200 standard osteogenic sarcomata nearly 50 per cent are still living under the 5 year limit. We feel much more sure of the correctness of diagnosis in most of these cases than in the 13 although in many much of the outline was behind the trees.

5. *The ultimate result.* It is easy to say that the Committee modify their diagnoses when they know the result. This is true we do so far as we can but in many cases we do not yet know the result. We have also been criticized for letting each expert see the opinions of those given before him. We are in fact glad to have him do so. We want every bit of information and advice we can get and so should every

expert. It can do no harm for we realize that on such data as we get this writing of opinions is often merely an amusing mental exercise.

To be sure there is a serious side when we think of how many unregistered cases of bone sarcoma do not even get the benefit of the opinion of the Registrar which is freely given for rich or poor and always should be. In our hospitals decisions in cases of bone sarcoma are often made on less experience than that which even a newly appointed Registrar would have at his command. Very few pathologists or surgeons see 10 cases of this lesion in their whole professional careers where the diagnosis is definite and the outcome known. A new Registrar who has studied this series of 650 cases could certainly be of help to anyone on whom the responsibility of decision of life and limb rests.

*But we must confess that even the most experienced after the study of all the 650 registered cases must sometimes modify his diagnosis by the ultimate result. If a case diagnosed as osteogenic sarcoma does not die within 5 years with metastases in the lungs all criteria should again be scrutinized with the greatest care.*

## PART II—THE 13 CASES OF 5 YEAR CURES OF OSTEOGENIC SARCOMA

As most of these cases have already appeared in the literature I will merely give references and discuss a few points in each.

CASE 20. This case has never been published in detail. It was that of a boy of 14 with a tumor of the upper end of the tibia. He was the nephew of an able surgeon who recognized the seriousness of the lesion at the time of onset and promptly did a thigh amputation. It is perhaps the record for prompt diagnosis and treatment. The patient has been well for 9 years. An interesting feature of this case was that postoperative treatment was conducted by Dr. James B. Murphy of the Rockefeller Institute on his theory derived from experiments in animals that a mild lymphocytosis repeatedly aroused by light diffuse doses of the roentgen ray prevents experimental inoculation of tumors in animals and therefore might prevent the growth of small metastases in the human being.

There are several of our criteria lacking in this case for instance the onset was with trauma not pain the history a matter of weeks rather than months no X rays or gross specimen have been preserved the hyperchromatism is not great nor are single mitoses very frequent. In fact the diagnosis is largely based on the extreme pleomorphism of the

TABLE II - FIVE YEAR CURES - THIRTEEN CASES

Case	Referred by	Nm	Age	Site	Previous history	Dt amp	Dt last report	Tx	Rd	Reported in
9	Hbb d	S	4	Tibia	0	6-23-6	Jan 10-5	0	0	Not reported
5	Rfd	O	44	Fem	0	1-100	Oct 9-6	0	0	B S g y vol u p 456
64	W U	B	0	Fem r	+	8-5-00	J 10-5	0	0	S g Cynece & Obst 10 M y p 603
100	Bloodgood & Col y	P	3	Fem	+	1-1	Apr 10-5	+	+	T be reported by Col y
	Bloodgood	NT	4	Fem	0	7-8-3	May 6-4	0	0	J R d i o M p 49
	Bloodgood	B		Tl	+	May 3	Apr 10-5	?	?	J R d i 1910 M p 248
73	Col y	S	0	Fem	?	1-1	Apr 10-5	+	+	T b p o t d by Col y
84	Col y	T	6	Fem	0	8-0-6	J 9-4	+	+	T be reported by Col y
6	Thompson	M		Fem	0	4-8-6	Oct 10-4	0	0	S g Cl f n th Am ca 9 Oct
48	Col y	D	8	Fem r	+	4-7-06	Apr 10-5	+	0	T be reported by Coley
5	Bloodgood	S	?	Fem	+	8-3	J 10-4	?	?	N t p t d
56	Col y	F	3	Fem	+	0-3-6	Apr 10-5	+	+	T be reported by Col y
83	Col y	t		Tb		N t m p t t d		+	+	T be reported by Col y

cells the presence of many typical tumor giant cells with multiple mitoses and Dr Mallory's original written report on the gross specimen. There is general agreement among the pathologists.

CASE 50 See Binnie's *Surgery* vol m p 456

This was a man of 2 with a very large tumor of the lower end of the femur. The case lacks some very important criteria. The age 44 was exceptional. There was little pain and tumor was the first symptom. The tumor had been present 3 years at least. It had differentiated largely to cartilage and bone and there was little cellular tissue. There are no X rays and no detailed description of the gross specimen. The diagnosis rests wholly on a few small areas which show a cellular growth with some mitotic activity and pleomorphism. Yet there is agreement among the pathologists on grading this as an osteogenic sarcoma rather than a benign or borderline chondroma. There are typical tumor giant cells.

The history however is strongly against this being a real case of osteogenic sarcoma. Patient has always been well except as to his left knee on which 3 years ago he first noticed a small lump on the outer side. This patient says was movable. Patient indicated that this was at the summit of the external condyle of the left femur. He knows of no injury save a slight blow at this point received some weeks before the lump was noticed. The lump has grown pretty continuously ever since although being stationary at times. It has never receded, has never been painful but was tender at one spot on the upper side of the patella. There is some tenderness in walking. Patient says that he has rather gained weight recently than lost.

Patients with osteogenic sarcoma of the femur do not usually walk 3 years without

pain and gain weight. This is the exception which proves the rule unless the histological malignancy in this case is the exception which proves another rule.

CASE 64 This case was reported by Wells. Neither gross specimen nor X ray was preserved. There were marked inflammatory signs. Repeated operations were done which might well have diffused metastases.

The diagnosis is based on expert opinion on the slides and is not strongly positive for most of the tissue is obviously inflammatory. While agreeing in the diagnosis there is evident doubt among all the pathologists.

CASE 100 After two incomplete operations the thigh was amputated. She was also treated by Coley toxins and radiation.

This case fulfills all the criteria with the possible exception of differentiation. The tumor is so well differentiated that the sections closely resemble callus. Otherwise than this and the survival after so much surgery, the case seems a typical osteogenic sarcoma.

CASE 101 The questionable features in this case were of its inflammatory nature, onset by fixation of joint rather than pain, the presence of many of the signs of inflammation clinically and in the sections, involvement of joint. No X ray is preserved and the character of the data is unsatisfactory. There is no agreement on classification among the pathologists except on the histological malignancy. There

is a question whether the tumor does not belong in the myeloma series

CASE 102 No X ray is preserved The data in general are unsatisfactory There is no good gross description of specimen but the histology is pretty typical of osteogenic sarcoma

CASE 172 The one favorable feature is Ewing's description of the amputated leg Shows early and unusually limited central and subperiosteal osteogenic sarcoma

CASE 184 The sections resemble a very cellular o testis fibrosa and some of the pathologists is class it as such The Committee however feels that it should be classed as a sarcoma Mitosis and hyperchromatism are not marked and differentiation is pretty complete We have no X ray and in such a case the X ray would mean much

CASE 261 This case has every unfavorable character except that the tumor was pretty well confined beneath the periosteum and in the center of the bone Histologically it was very malignant Amputation was done without exploratory incision and there was no after treatment It is in my opinion the most typical and also the most complete case in the series It shows surgery at its best

CASE 408 The character of the exploratory operation through the joint rendered the prognosis very unfavorable We have no good report of the gross specimen or X ray However there can be little doubt from the description of the operation and the histology that this was a malignant tumor It hardly seems as if amputation alone could have cured in this case No radiation was used according to our notes the mixed toxins were used Compare the preceding case in which no exploration was done or after treatment given

Although the pathologists agree that this case was malignant the histology is unsatisfactory for classification

CASE 501 The notes on this case are very inadequate There is no real history no X ray and the histology is barely adequate to include it in this group Several pathologists have raised the question of its being a giant cell tumor Complete data even one good X ray would probably expel all doubt

CASE 586 This case is well registered with X rays photos and slides but it is really not one of the true osteogenic sarcoma Had fractured femur at 4 and 11 At 21 had slight periostitis at site of fracture In August 1916 when 48 years old he had a tumor of the femur at the site of one of the fractures He was treated by curettage X ray radium and toxins for several months and the thigh amputated October 1916 Well in April 1925 There was a fairly circumscribed mass at the site of the fracture and an open granulating wound over it Histologically it is a sarcoma There is doubt among the pathologists as to whether it should be classed as an osteogenic sarcoma at all or as a fibrosarcoma arising in scar tissue

CASE 183 This case is the only one in which amputation did not contribute to the success which

must have been due to radiation or toxins or both It has been and will be again reported by Dr Coley in full It is a unique remarkably encouraging case for the limb was saved and metastases in the glands of the groin receded and did not reappear Logically the mixed toxins and radiation must share the credit There is an almost equally brilliant case, 267 among the Ewing tumors, also treated by radiation and toxins

#### SUMMARY

One must realize that the cases here presented are by no means the only possible 5 year cures of osteogenic sarcoma in the Registry series It would be better to say that they are the 13 most authentic ones Other cases especially Case 187 should perhaps also be included and discussed but there is a limit to interest in the subject if too doubtful instances are brought into question

I have done my best to be judicial in selecting these and my colleagues Doctors Blood good and Ewing have agreed with me that these are the best representatives of cured osteogenic sarcoma and even these are pretty doubtful If it had not been for Coley's enthusiasm and optimism we should have few to record Coley has shown us at least that cases considered hopeless may be cured Even if the hopelessness was due in some cases to the errors of pathologists in mistaking benign tumors for malignant ones Coley's optimism has been well justified Whether or not the evidence also justifies his faith in the use of mixed toxins is an academic matter compared with the bald facts that he can furnish evidence of the cure of apparently hopeless cases and that he has furnished evidence of nearly as many cures as all the other surgeons of the country together He has also furnished evidence of more cures than shown in the above list but some of these other cases are considered by our Committee to be instances of benign giant cell tumor

From a logical standpoint it seems to me that argument as to the value of the toxins should rest on their postoperative use for the fact is that over one half of the successful cases following amputation have had the postoperative use of this agent To be sure there are few in all

Further evidence of the value of the mixed toxins will appear in Conner's paper on

Ewing's tumor in the *Archives of Surgery* but as in these cases there was confusion owing to coincident use of radiation

Of the present series of 13 in 5 cases amputation must be given the credit alone unless the Murphy method of diffuse X ray is claimed to share one of these (Case 29) This idea of Murphy's seems to me to deserve more extended trial

In two other cases (102 and 501) we do not know whether the toxins were used or not

In 5 cases they were used before or after operation but in only one of these was radiation not used also

Finally in 1 case the cure must be credited to either toxins or radium or both This case was unique in many respects but clearly histologically malignant

Another point brought out is interesting In only 5 cases was the amputation done

at the same time as the exploration In the other 7, exploration was done at least once and in some cases several times before amputation Even if done only once it was done in a manner which should have caused diffusion of the tumor

In only 1 case was the amputation done without preliminary incision *but this was the most typical malignant case*

These facts speak in two ways either against the malignancy of these particular tumors or in favor of exploration being a harmless procedure

I have presented what I believe to be the best evidence of 5 year cures so far collected by the Registry We can continue to guess on the strength of these meager facts or we can co operate to collect a more complete series

Shall the College continue the Registry of Bone Sarcoma?



# STAPHYLOCOCCUS MENINGITIS SECONDARY TO A CONGENITAL SACRAL SINUS

WITH REMARKS ON THE PATHOGENESIS OF SACROCOCCYGEAL FISTULE

By THEODORE S. MOISE, M.D., NEW HAVEN, CONNECTICUT

F. m. the D. partm. 1 of S. rg. ry. 1st. Lal. ty. Scho. l. Medicine. 4. dth. S. gr. l. Clinic. 1st. N. w. l. ve. H. pt. l.

THE purpose of this paper is to report a case of meningitis secondary to a congenital sacral sinus in which recovery followed a lumbar laminectomy with drainage. The case is interesting first on account of the unusual portal of entry second on account of its bearing on the pathogenesis of congenital sacral sinuses and third as a case of meningitis in which recovery followed surgical drainage.

The patient, a white male aged 18, was admitted to the New Haven Hospital on September 10, 1924, complaining of a headache and pain in his back. The patient had always had a sinus in the lower lumbar region of his back. At irregular short intervals there had been a discharge of a watery fluid.

One week before admission he noticed that the area surrounding this sinus was tender. This gradually became worse. After 2 or 3 days his spine began to ache. On the day before admission his head commenced to throb. He described this as a splitting headache. He has had some general malaise and anorexia. He has had no nausea, vomiting or convulsions. The family history and personal history are irrelevant. The temperature was 101.8 degrees F., pulse 86 and respirations 20 per minute. The patient appeared acutely ill, his face was flushed and his expression was somewhat anxious. The neck was markedly stiff. The heart, lungs and abdomen were normal. The biceps and triceps tendon reflexes were normal. The knee jerks and ankle jerks were absent. Kernig's sign was positive. In the midline over the lower lumbar and upper sacral region there was a small sinus surrounded by which the skin was red and tender. A slight amount of thin pus could be expressed from the sinus.

A lumbar puncture was done with removal of 35 cubic centimeters of cloudy fluid under increased pressure. Examination of this fluid showed 1,450 cells per cubic millimeter. The cells were largely polymorphonuclears. A few Gram positive cocci were seen in a stained smear. The Ross Jones and Pandey tests were positive for globulin. A culture showed a hemolytic staphylococcus albus. A blood culture showed no growth after 5 days.

A roentgenogram of the sacrum showed a sacralization of the fifth lumbar vertebra, an irregularity in the fusion of the spines of the fifth lumbar and the first sacral vertebrae and a flattening of the spine of the first sacral segment with a defect below this level (Fig. 1).

The patient was treated with daily lumbar punctures. The fluid remained cloudy with a cell count varying from 800 to 3,300 white blood cells per cubic millimeter. Cultures were repeatedly positive for staphylococcus albus.

September 20, 45 cubic centimeters of spinal fluid, cell count 990, were removed and 20 tuberculin units of the patient's blood serum which had been prepared a few hours previously were injected into the spinal canal.

September 21. The patient complained of severe headache and generalized pain which was most severe in his back and legs. The temperature was 101.6 degrees F., pulse 104 per minute. A cell count of the spinal fluid was 3,300 per cubic millimeter.

Clinical diagnosis: pyogenic meningitis, spinal abscess, occulta staphylococcus meningitis.

Operative note, September 23, 1924. The sinus was injected with methylene blue and excised with the surrounding tissue. The sinus extended through a small bony defect (measuring about 2 centimeters in diameter, Fig. 12) just to the right of the midline at the junction of the first and second sacral vertebrae. The incision was then extended and a laminectomy performed. The spine of the first sacral vertebra was flat. The spinous process was removed from the first sacral segment. The defect was enlarged by removal of the lamina of the first and second sacral vertebrae.

The underlying dura was stained deeply with methylene blue. There was a tuft of granulation tissue just beneath the defect in the spinal column. This was excised after the dura had been opened. The spinal fluid was stained with methylene blue. The dura was left open. A small rubber tissue drain was inserted through the upper part of the incision down to the dura. The wound was closed in layers.

Pathological note. Microscopic examination of the excised sinus showed a lining membrane of several layers of stratified squamous epithelium surrounded by a dense fibrous wall.

The patient's temperature had ranged between normal and 103 degrees F. up until the day of operation. On the following day it fell to normal. There were occasional elevations to 102 degrees F. during the first 14 days after operation when it became normal and remained so until he was discharged. The drainage of spinal fluid continued for 9 days following operation. The postoperative convalescence was uneventful except for frequent severe pain in his lower back and legs. He was discharged on November 17, 1924. At the time of discharge a neurological examination was negative and the patient was well.



Fig. 1. Diagrammatic drawing showing outline of the lower lumbar vertebrae and the sacrum. There is a sacralization of the fifth lumbar vertebra with an irregularity of the lamina and process of the first sacral segment. The spine of the first sacral segment is flat and its lamina asymmetrical. Below this level the sacral segments are not fused and a bony defect is seen.

This case presented a sinus similar to the usual pilonidal sinus. It was situated over the upper end of the sacrum and was not a blind pouch but extended through a bony defect directly into the spinal canal. There was a history of irregular short intervals during which a thin watery fluid (presumably spinal fluid) escaped freely. This intermittent free drainage is quite possibly responsible for the fact that the patient had not suffered from meningitis at an earlier date.

The meningeal infection was apparently progressing badly under conservative treatment consisting of daily lumbar punctures and a single intraspinal autoserum injection. The sinus was excised and a laminectomy with drainage performed. Following surgical drainage the convalescence was uneventful and the patient was well when discharged from the hospital.

#### PORTAL OF ENTRY

Although congenital dimples, sinuses, and cysts are commonly observed, a review of the literature shows no instances in which such a sinus has been the portal of entry for a late meningeal infection. These fistulae are commonly known by the name of pilonidal sinuses.

This common lesion for which surgical advice is sought is a small congenital opening situated in the midline over the coccyx, the sacrococcygeal articulation or over the lower end of the sacrum. These sinuses practically always lead upward and toward the midline. They are lined with stratified squamous epithelium although this lining membrane is frequently absent due to an inflammatory

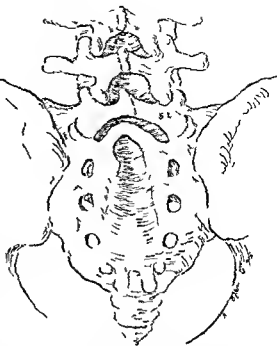


Fig. 2. Diagrammatic drawing showing the sinus extending from the skin surface directly into the subdural space through the bony defect below the lamina of the first sacral vertebra.

process. Not infrequently a tuft of hair is seen within these sinuses. As a rule, a spina bifida is not found.

There have been various theories advanced to explain the origin of these fistulae. These theories have been reviewed by Mallory (1) in 1897 and Stone (2) in 1924. After studying a series of fetuses of 3 to 6 months old, the former author concludes that pilonidal sinuses arise from a persistence of the medullary canal. He states: "These cases show that in fetuses of 3 to 6 months there is very frequently present over the coccyx a canal lined with epithelium—in some cases connected with the skin in others not—in some situated near the skin in others near the coccyx. The question naturally arises as to their origin. They may be due either to an extension inward of the epidermis or to the remains of some canal. If due to an extension inward or as Lannelongue assumes to the skin being bound down to the coccyx, why do they not contain the glands and hair follicles with which the epidermis in that region is studded? As regards an extension inward

# STAPHYLOCOCCUS MENINGITIS SECONDARY TO A CONGENITAL SACRAL SINUS

WITH REMARKS ON THE PATHOGENESIS OF SACROCOCCYGEAL FISTULE

By THEODORE S. MOISE, M.D., NEW HAVEN, CONNECTICUT

From the Department of Surgery, Yale University School of Medicine, and the Surgical Clinic of the New Haven Hospital

**T**HE purpose of this paper is to report a case of meningitis secondary to a congenital sacral sinus in which recovery followed a lumbar laminectomy with drainage. The case is interesting first on account of the unusual portal of entry, second on account of its bearing on the pathogenesis of congenital sacral sinuses, and third as a case of meningitis in which recovery followed surgical drainage.

The patient, a white male, aged 18, was admitted to the New Haven Hospital on September 10, 1924, complaining of a headache and pain in his back. The patient had always had a sinus in the lower lumbar region of his back. At irregular short intervals there had been a discharge of a watery fluid.

One week before admission he noticed that the area surrounding this sinus was tender. This gradually became worse. After 2 or 3 days his spine began to ache. On the day before admission his head commenced to throb. He described this as a splitting headache. He has had some general malaise and anorexia. He has had no nausea, vomiting, or convulsions. The family history and personal history are irrelevant. The temperature was 101.8 degrees F, pulse 86 and respirations 20 per minute. The patient appeared acutely ill. His face was flushed and his expression was somewhat anxious. The neck was markedly stiff. The heart, lungs and abdomen were normal. The biceps and triceps tendon reflexes were normal. The knee jerks and ankle jerks were absent. Ferriss sign was positive. In the midline over the lower lumbar and upper sacral region there was a small sinus, surrounding which the skin was red and tender. A slight amount of thin pus could be expressed from the sinus.

A lumbar puncture was done with removal of 35 cubic centimeters of cloudy fluid under increased pressure. Examination of this fluid showed 1,450 cells per cubic millimeter. The cells were largely polymorphonuclears. A few Gram positive cocci were seen in a stained smear. The Wassermann and Pandy tests were positive for globulin. A culture showed a hemolytic staphylococcus albus. A blood culture showed no growth after 5 days.

A roentgenogram of the sacrum showed a sacralization of the fifth lumbar vertebra, an irregularity in the fusion of the spines of the fifth lumbar and the first sacral vertebrae, and a flattening of the spine of the first sacral segment with a defect below this level (Fig. 1).

The patient was treated with daily lumbar punctures. The fluid remained cloudy with a cell count varying from 800 to 3,300 white blood cells per cubic millimeter. Cultures were repeatedly positive for staphylococcus albus.

September 20. 45 cubic centimeters of spinal fluid, cell count 900, were removed and 20 cubic centimeters of the patient's blood serum, which had been prepared a few hours previously, were injected into the spinal canal.

September 21. The patient complained of severe headache and generalized pain which was most severe in his back and legs. The temperature was 101.6 degrees F, pulse 104 per minute. A cell count of the spinal fluid was 3,300 per cubic millimeter.

Clinical diagnosis: pyogenic meningitis, spinal abscess, staphylococcus meningitis.

Operative note, September 23, 1924. The sinus was injected with methylene blue and excised with the surrounding tissue. The sinus extended through a small bony defect (measuring about 1 centimeter in diameter, Fig. 12) just to the right of the midline at the junction of the first and second sacral vertebrae. The incision was then extended and a laminectomy performed. The spine of the first sacral vertebra was flat. The spinous process was removed from the first sacral segment. The defect was enlarged by removal of the lamina of the first and second sacral vertebrae.

The underlying dura was stained deeply with methylene blue. There was a tuft of granulation tissue just beneath the defect in the spinal column. This was excised after the dura had been opened. The spinal fluid was stained with methylene blue. The dura was left open. A small rubber tissue drain was inserted through the upper part of the incision down to the dura. The wound was closed in layers.

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septic meningitis. He states that three types of treatment have been tried (1) intermittent drainage by repeated lumbar punctures (2) continuous drainage from (a) spinal canal (b) cisterna magna (c) pontine cisterna (d) lateral ventricles (e) subarachnoid space, (3) irrigation of subarachnoid space.

He believes that intermittent drainage can have only slight if any beneficial effect and calls attention to the fact that there have been a few scattered cases of spontaneous cure, which casts some doubt whether many recoveries apparently resulting from one or another form of drainage may not have occurred in spite of rather than as a result of the treatment. He believes that mechanical injections may be harmful and even though there is no harmful effect that irrigations sufficiently frequent to be beneficial are impractical.

He advocates continuous drainage from the cisterna magna as the operation of choice and reports a series of four cases in three of which recovery followed such drainage.

In the case here reported the pathway of infection was through a congenital sacral sinus into the lower spinal canal with gradual extension of the infection upward. This of course gave a direct indication for surgical drainage in this region.

#### SUMMARY

The sacro-lumbar region is a common site for developmental anomalies among which are included the above mentioned congenital dimples, sinuses, cysts and tumors. These cases

rarely present a connection between the spinal canal and the skin surface.

Other congenital lesions occurring in this region are instances of spina bifida with all gradations from an unnoticed spina bifida occulta with no external evidence of a defect to a fusion of the spinal cord with the integument. The cases showing a connection between the spinal canal and the exterior do not as a rule survive infancy.

The case herewith reported showed a congenital sacral sinus with an underlying spina bifida and a direct connection between the skin and the spinal canal. The occurrence in this case of a pilonidal sinus with an underlying spina bifida and an irregularity in the fusion of the sacral vertebrae is additional evidence in favor of the view that such sinuses are developmental anomalies resulting from a failure of the medullary canal to become completely obliterated.

This lesion had given the patient no cause for worry until the eighteenth year of his life when it served as the portal of entry for a meningeal infection.

A sacral laminectomy with drainage was performed with subsequent recovery from the meningitis.

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2. STONE, H. B. Pilonidal sinus (coccygeal fistula). *Ann. Surg.* 1924, lxxix, 470.
3. DANDY, W. E. The treatment of staphylococcus and streptococcus meningitis by continuous drainage of the cisterna magna. *Surg. Gynec. & Obst.* 1924, xxxix, 760.

of the skin why should it occur here so often and nowhere else? It seems more likely that they are due to incomplete obliteration of a former canal and extending as they all do upward and posteriorly to the coccyx the medullary canal seems the most likely origin. The branchial clefts are closed by the eighth week. As before stated the medullary canal has been seen open as late as the ninth week. Consequently the obliteration of the clefts in the one case, and of the medullary canal in the other must take place at about the same period of intra uterine life with this difference that growth is more rapid and perfect in the upper part of the body and hence more favorable to closure of the clefts. If notwithstanding this sinuses and cysts occur in the neck and about the ears there is at least an equal chance that they may occur at the lower end of the medullary canal.

"It would seem from a study of the sections from these fetuses that obliteration of the medullary canal takes place at first and most completely at the lower end of the sacrum and extends from this point in both directions.

As is well known the spinal cord at first extends the whole length of the vertebral canal but as the latter grows the more rapidly in length the cord rises and the filum terminale is stretched thus favoring obliteration of the medullary canal at the lower part. The obliteration of the medullary canal between the end of the vertebral canal and the skin apparently frequently takes place in an irregular manner, but for that matter the medullary canal in the spinal cord shows frequent irregularities sometimes existing as a distinct canal sometimes double and often showing in sections only as a very irregular clump of cells.

Undoubtedly the majority of these remnants of the medullary canal become obliterated—only the larger especially those in which glands and hairs are present persisting as the depressions sinuses and cysts of extra uterine life and in all probability it is only the congenital sinuses and cysts which give rise to the suppurating sinuses.

On the other hand Stone believes that the skin and not the neural groove is the source of these sinuses and states. In spite of these

advantages no satisfactory explanation of the problem has yet been found. It is true that for a time a small cystic remnant of the lower most portion of the medullary groove persists and is known as the 'coccygeal medullary vestige'. This is lined by a single layer of columnar cells and is doubtless the structure to which Hermann and Tousseux have referred. Normally this little cystic structure has no opening communicating with the skin and ultimately disappears. Furthermore its cells are similar in appearance to those lining the central canal of the spinal cord and in Doctor Streeter's opinion have already become so differentiated that they could not be expected later to give rise to skin even though the cystic remnant should persist. It is Doctor Streeter's view that pilonidal sinus must be regarded as a special local downgrowth of epithelium originating from the true skin and not from the medullary groove. The skin in certain regions forms organs like the breast and the external ear by just such an invagination. No suggestion is as yet advanced as to why such an invagination takes place occasionally in the coccygeal region. In short beyond the feeling that the skin and not the neural groove is the source of the sinus no facts are present to explain the origin of the lesion.

However the facts which have been advanced by Mallory are of sufficient importance to throw the weight of evidence in favor of his contention that the sinuses are developmental anomalies resulting from a partial closure of the medullary canal. Furthermore the case here reported shows an irregular fusion of the lamina of the first sacral vertebra an absence of the spinous process of the second sacral vertebra with a bony defect at the junction of the first and second sacral segments and an opening directly into the spinal canal which is additional evidence in favor of the view that these sinuses develop from a failure of the medullary canal to close in the normal manner.

#### SURGICAL DRAINAGE IN MENINGITIS

In a recent article Dandy (3) has reviewed the literature on the operative treatment of

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It is interesting to consider the causes of these sacculations and stomata. No one has discussed this phase of the subject except Pidcock. He investigated the bodies of ten adult females. He could stretch the round ligaments forward thus demonstrating a thin avascular fold of peritoneum which joined this to the main part of the broad ligament. It required but little force to perforate this membrane with the finger. He suggests as a possible cause of the condition in his patient that all the structures connected with the uterus were in a relaxed condition as a result of the pregnancy and that a coil of intestine had in some manner, ruptured this meso-ligamentous fold. This explanation is plausible but in my case it is probable that congenital stomata existed. This is suggested because both of the broad ligaments contained openings of about the same size which were symmetrical and with smooth edges. The appendix was attached to the lower border of the opening on the right side and no evidence existed of previous inflammation. It is also probable that the hernia with obstruction in Barr's patient occurred through a congenital opening.

Our knowledge of the embryological development of the broad ligament gives no clue to the production of congenital windows in this structure. No observation seems to have been made of openings or sacculations of either congenital or postnatal origin except those cases reported by Barr and myself.

#### DIAGNOSIS

A pre-operative diagnosis of hernia into the broad ligament has not been made. The diagnosis ordinarily will be that of intestinal obstruction. Vomiting occurred in all of the cases with obstruction. In the cases reported pain and tenderness were present simulating in situation and severity that of gall stones, appendicitis, torsion of an ovarian cyst and of an obdurator hernia. The pain may be agonizing or it may be of any grade of severity. Tenderness and rigidity may be present over the left or the right iliac region according to the situation of the lesion. In only one case could a distinct mass be made out by vaginal or rectal examination. In my case, resistance

could be detected but no tumor could be outlined.

Non obstructive hernia into the broad ligament may be indicated by periodic pains. When the intestine passes through an opening certain movements or position of the body may pull on the mesentery inducing the same sort of pain produced by a tug on the intestine when the abdomen is opened under local anesthesia. The absence of pain during pregnancy is due to the closure of the opening as the uterus ascends. The outstanding diagnostic fact to remember is that in acute obstructive conditions, hernia into the broad ligament is one of the possibilities which should be considered.

We are fortunate to be able to illustrate by case histories hernias in these different situations showing the conditions that may be found and the treatment that was used in each instance.

**CASE 1.** The author's case. My interest in this subject was stimulated by a patient seen on January 30, 1919. She gave the following history: Mrs. H., age 44, married, was the mother of five children, four of whom were living and well. Her labors were without incident. In 1904, a chair on which she was standing tilted suddenly. She was thrown forward, landing on her feet, receiving such a jar that 3 days later she miscarried. Following this accident she had so much pain in the abdomen for a year or more that she could do no lifting, neither could she hold a child in her lap. For the past 15 years she could not lie on the left side except when she was pregnant without causing an intense pain which if the position were not changed would extend over the entire lower abdomen. Reaching upward caused an acute pain followed by a sense of weakness which might last for some time. Sexual intercourse was uncomfortable during the past 4 years. Four labors and two miscarriages have occurred since the accident.

Nothing abnormal was found in the head, chest, heart or kidneys. There was neither dullness nor tenderness of the abdomen. A vaginal examination disclosed an old perineal laceration and a bilateral cervical tear from which there was a profuse discharge. The uterus was in normal position. Neither tumor nor induration was found to the right or posteriorly. However, there was an indefinable sense of resistance to the left which could not be definitely outlined. This area was not particularly tender but a dull ache followed the vaginal examination.

On February 1, 1919, under local anesthesia the cervical and the perineal lacerations were repaired and hemorrhoids were removed with clamp and cautery. The abdomen was opened in the median line suprapubically. The hand encountered a mass

# HERNIA IN THE BROAD LIGAMENT FROM THE CLINICAL VIEWPOINT

REPORT OF A CASE AND A REVIEW OF THE LITERATURE

By LOUIS DUVV M.D. MINNEAPOLIS MINNESOTA

ONLY four histories of hernia in the broad ligament have been recorded. It is thought desirable to bring these together and to add a fifth one thus making the subject more complete.

The extreme rarity of this condition its seriousness the necessity for prompt intervention the value of a more general knowledge of the situation of this form of hernia which usually comes under treatment for acute intestinal obstruction and the importance of the treatment which should be employed are the motives for the presentation of this article with the report of the case that came under my care.

## ANATOMICAL CONSIDERATIONS

The broad ligaments of the uterus are extensive fibromuscular planes extending from the lateral borders of this viscus to the walls of the pelvis. The round and the utero ovarian ligaments form parts of this structure. The peritoneum is thrown over all like a mantle. The round ligament makes a prominence under the peritoneum but it does not project sufficiently to form a meson. Where the peritoneum covers the utero ovarian ligaments it forms a short meson and a similar structure the mesosalpinx is produced where it surrounds the fallopian tube. One of the more practical points in the consideration of broad ligament hernias is the division of the upper posterior surface of the ligament into two spaces by the utero ovarian ligament with the border of the ovary. These structures divide this surface unequally into an upper triangular portion the mesosalpinx and the lower part the mesometrium which passes medially to the side of the uterus.

## HISTORICAL

No record of this condition was published prior to 1917, although Barnard (1) had stated

that hernias may occur in pouches of the broad ligaments and Moynihan also mentioned this possibility.

In 1917 Fagge (3) described two cases. Barr (2) reported a third case in 1920 and Pidcock (5) a fourth one in March, 1924. It is evident that this condition has been observed more frequently than it has been reported. Of the five cases of hernia in the broad ligament two were found in adventitious pouches and three through openings in it.

Fagge's two cases were incarcerated in pouches within the broad ligaments. One was on the left side below the utero ovarian ligament and the other on the right above. In 3 cases the hernias were through openings one under the left round ligament and two through openings in left mesosalpinx. The lengths of the incarcerated intestines were 2 inches 12 inches 15 inches (author's case) and 8 feet respectively the last requiring resection.

## ETIOLOGY

These histories show one patient unmarried and four married and with children. In one of the latter obstruction occurred on the fourteenth day following delivery. In this instance the intestine passed under the round ligament. In two other cases the intestine was found in an opening in the mesosalpinx. One patient had fallen down stairs 14 years before operation but the obstructive symptoms followed straining at stool. Another dated her symptoms from a fall from a chair 15 years before. She never experienced obstruction only a pain when lying on the left side.

The intestine in these five cases entered the openings from above and behind. This is the plane in which the broad ligaments present to the intestines and upon which the intra-abdominal pressure would be exerted in developing a fossa in a weakened spot in the broad ligament or stretching a congenital opening.

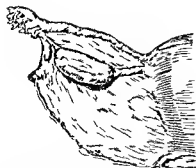


Fig 1 Adopted from Solotta McMurich The division of the upper posterior surface of the ligament into two spaces by the utero-ovarian with the border of the ovary with the result that this surface is divided unequally into an upper triangular portion the mesosalpinx and the lower part the mesometrium which passes medially to the side of the uterus

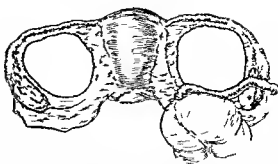


Fig 2 Each broad ligament presented a window 5 centimeters in diameter limited anteriorly by the tube and posteriorly by the attenuated utero-ovarian ligament and the ovary The proximal end of the appendix extended parallel with and was attached to the posterior edge of the window of the right broad ligament the distal end pointing to the right

bowel movement for 48 hours Digital examination was negative The temperature was 98 the pulse 78 and of good volume Heavy albumin with granular and hyaline casts was present in the urine

On the third day she was operated upon A suprapubic median incision allowed a considerable quantity of cloudy fluid to escape Inspection revealed about 12 inches of the small intestine passing through an opening in the left broad ligament and tightly constricted Traction failed to dislodge the imprisoned gut The aperture was enlarged by tearing with the finger releasing the intestine Hot saline sponges restored the circulation in the gut Considerable hemorrhage occurred as the result of rupture of the ovarian vessels where the opening in the broad ligament was enlarged Relief of pain nausea and vomiting was immediate and complete The patient made an excellent recovery

CASE 4 (Fagge's first case) Mrs J age 61 The only history of any accident was a fall down stairs in 1902 Beyond a hemistemesis in 1906 there was no history of any abdominal trouble She was the mother of five children On December 9 1917 while straining at stool she was suddenly seized with abdominal pain This pain was referred to the left iliac region She vomited several times Nothing was to be made out on abdominal examination except marked tenderness low down in the left iliac region The tongue was clean but her aspect was anxious No exact diagnosis was attempted before operation Conditions considered were torsions of an ovarian cyst strangulated obducatory hernia and mesenteric thrombosis When under the anesthetic a vaginal examination detected fullness of the left vaginal fornix and a rectal examination confirmed the presence of a mass in Douglas pouch

Abdominal incision exposed small intestine and lower down and to the right a coil of ileum which was distended and purple It could not be drawn

out and was evidently held down in the pelvis This and another collapsed coil were traced down to the left side of the pelvis where they were caught and held tensely as they passed through a small hole in the peritoneum They were obviously the afferent and efferent limbs of the strangulated loop which could be seen and felt under a layer of peritoneum filling up the left half of the pelvis It was thought at first that the orifice was the entrance to the inter sigmoid fossa but the peritoneum passed over the pelvic brim to the left and below its margin was continuous with a tense layer of peritoneum passing on to the side of the uterus The margin of this opening was divided by scissors allowing the distended loop of the ileum to be withdrawn when it was found that this loop had passed from behind forward into the broad ligament and filling up Douglas pouch had formed the mass which was palpable through the rectum and vagina The loop actually strangulated was 10 inches long The gut was viable The opening in the broad ligament just below and median to the ovarian ligament was closed by a continuous catgut suture A large rubber drain was passed into Douglas pouch In February 1917 the patient had another severe attack of left sided abdominal pain This recurred in March The abdomen was reopened at Guy's Hospital on March 12 1917 and extensive adhesions between the scar and the lower ileum were freed The opening to the left broad sac had remained closed

CASE 5 (Fagge's second case) Miss P age 49 was seized with abdominal pain on November 30 1917 She vomited at intervals The next morning she did not appear acutely ill but she vomited occasionally and the pain was not severe The next day she fainted On December 3 she continued to vomit occasionally and the pain located in the middle of the abdomen was severe There was now slight rigidity and tenderness over the right rectus slightly internal to McBurney's point



of small intestine that was fixed in the left pelvis (ood exposure disclosed 15 inches of intestine projecting through an opening in the mesosalphix. This opening was approximately 5 centimeters in diameter and was of sufficient size readily to permit the withdrawal of the intestine. It was limited anteriorly by the tube and posteriorly and to the inner side by the attenuated utero ovarian ligament and the ovary. The aperture was closed with chromic catgut. The needle was passed very close to the edge of the opening which drew the tube to the side of the uterus. Further examination of the pelvis located a similar opening of the same size in the right broad ligament. This aperture lay between the tube and the utero ovarian ligament. No intestine occupied this opening but the appendix extended parallel with and was attached to its lower margin. The proximal end of the appendix was attached to the posterior edge of the hernial opening the end pointing to the right. It was removed and the opening in the mesosalphix obliterated as on the left side. A survey was made of the pelvis and since it was found that the left tube had become cyanotic from impairment of its blood supply it was removed. The right tube was examined again and its circulation seemed unimpaired.

The convalescence was uneventful the patient returning home at the end of 2 weeks. However on the way from the hospital she developed an intense pain in the right iliac region. This pain with an elevated temperature continued for a week. A vaginal opening was then made into the right broad ligament at the point of induration and tenderness. This released a considerable quantity of serous exudate but no pus. The patient made a rapid recovery and has been well since. This postoperative disturbance was doubtless due to interference with the blood supply of the right tube.

It is an interesting speculation as to the length of time the intestine had occupied the opening in the broad ligament. It is conceivable that with the fluid content of the small intestine such a condition was possible without obstruction occurring during the period of years she suffered following the injury. The fact that she was comfortable when pregnant and has been completely relieved since the operative obliteration of these stomata supports the inference that the intestine probably occupied the ostia in the broad ligament the greater part of this time for when she lay on her left side she always had pain.

CASE 2 (Hidcock) Mrs. V. age 34. Fourteen days previous to entering the hospital she had a normal labor the pregnancy and puerperium being without incident. While bathing her baby she was seized with sudden and violent pain in the region of the navel. The pain was continuous and very acute. Two hours later vomiting began and returned at intervals all afternoon. No feces or gas passed after the onset of symptoms. A ventral hernia never larger than a pig on a egg had existed on the left side for 5 years. This always disappeared when she lay down. It was not present at the time of

examination and was probably inguinal. Her temperature was 97.5 degrees her pulse rate 63 and very weak. She complained all the time of agonizing abdominal pain. The face was cold and bedewed with sweat. The abdomen was lax with no distention nor visible peristalsis. Some fluid was present in the flanks. Slight tenderness and rigidity were discovered in the lower part of the left iliac fossa. No mass was felt.

The diagnosis lay between an acute perforation and acute intestinal obstruction. The latter seemed more likely.

On opening the peritoneal cavity, free bloody fluid escaped the abdomen being apparently filled with plum colored coils of small intestine. The cecum was collapsed but otherwise healthy. A band was felt rather to the left side and in front of the uterus. This was divided between forceps relieving thereby the strangled gut. A small artery was distinctly seen in the center of the cut band. Careful investigation showed the strangulating agent to be the left round ligament one end of which was traced to the internal abdominal ring and the other directly to the uterus. The ligament measured 4 inches in length and before division the middle 3 inches were quite free from the broad ligament. There appeared to be no evidence of old pelvic inflammation such as might give rise to adventitious bands simulating the round ligament. The coils of strangulated intestine were evidently on the verge of gangrene and required the excision of 8 feet of the small gut. The convalescence was stormy and on the seventeenth day necessitated the reopening of the abdomen with drainage of an abscess localized between coils of intestine. Fourteen days later a perinephric abscess required evacuation. From this time on convalescence was without further incident.

CASE 3 (Barr) Mrs. L. H. age 44. Mother of seven children youngest seven years. She had had four miscarriages and had not menstruated within 8 years. Her previous health had been good. On January 15, 1920 she was suddenly seized with a severe pain in the epigastrium. This was more severe to the left of the median line and radiated downward to the left pelvis. Her physician found the most sensitive point to be to the right of the median line and over the gall bladder. The pain was general throughout the abdomen although more severe at the point named. It was constant with accentuations at short irregular intervals. Nausea and vomiting were prominent symptoms. Morphine was administered for the relief of pain. A diagnosis of gall stone colic was made and concurred in by three physicians.

Barr saw her on January 17, the third day following the onset of the attack. At this time the patient was suffering excruciating pain throughout the abdomen although it was most intense to the left of the median line in the left pelvic region. There was excessive and persistent nausea with vomiting on taking food or fluids. Moderate abdominal rigidity was present. There had been no

# DEPARTMENT OF TECHNIQUE

## A METHOD OF PARTIAL GASTRECTOMY WITH TELESCOPIC ANASTOMOSIS

BY W. WAYNE BABCOCK, M.D., F.A.C.S., PHILADELPHIA

I AM persuaded that the ideal method of anastomosis after partial gastrectomy is an end-to-end union between the stomach and duodenum. The stomach then empties directly into the duodenum which has a mucosa and alkaline fluids particularly adapted for handling the erosive chyme. Secondary marginal ulcer is then rarely to be feared. The normal intestinal current lines are maintained. The duodenal hormone is formed under conditions that approximate the normal. There is no reason for the secondary degeneration of the pancreas mentioned by Borodenko as following a lower point of anastomosis. The main intestinal stream is not shunted from the stomach to the jejunum and therefore reflux into the eliminated duodenum with distention and possible opening of the duodenal stump or stagnation inflammation ulceration cannot occur. Ochner's muscle the sphincter of the duodenum and the barrier against overloading of the jejunum and ileum may be retained to regulate the emptying of the stomach and maintain the ileopyloric reflex. The jejunum is not disturbed and secondary symptoms from its adhesion angulation or torsion are eliminated. The mesentery of the transverse colon is not opened and herniation into the lesser peritoneal cavity is not to be feared. Large or small intestinal loops that favor obstruction or herniation are not produced. A secondary entero-entero-anastomosis is not required. A single zone of the digestive tube is subjected to suture instead of two or more zones. Finally my personal late results from end-to-end suture have been satisfactory. Many reasons therefore confirm the belief that when it is feasible an end-to-end anastomosis is the most nearly physiological and anatomical method in partial gastrectomy.

The objections to an end-to-end union between the stomach and duodenum are

1 The disproportionate size of the openings in the stomach and duodenum producing technical difficulties especially when large resections of the stomach are necessary.

2 Excessive tension with the danger of secondary separation and leakage at the suture line.

3 Secondary narrowing of the new opening with obstruction.

4 Difficulties in mobilizing the duodenum with danger of hemorrhage leakage or damage to the pancreas the pancreatic or biliary ducts.

Difficulties in uniting the cut end of the duodenum with the stomach have been emphasized by the use of clamps and the failure of the operator to attempt that which at the onset seems almost impossible the fitting together of the edges of openings very different in size. Under peristaltic contraction however the diameter of the stomach closely approximates that of the relaxed duodenum. By making a transverse instead of an oblique section of the stomach by stretching the end of the duodenum to its greatest diameter by spacing the sutures so that they are three or four times as far apart on the gastric as on the duodenal side we have repeatedly been able to make a satisfactory end-to-end anastomosis when from one half to two thirds of the stomach have been removed. Expedients employed largely in earlier cases before we discovered the feasibility of a pure end-to-end union included modifications of the Billroth I method in which the duodenum was implanted at the upper angle or middle of the gastric incision and the enlargement of the duodenal opening by secondary incisions through the superior or inferior wall (Fig. 3). These methods are useful to meet conditions found in individual cases. With proper mobilization of the duodenum and stomach it is rare that the openings of the stomach and duodenum cannot be apposed when not more than two-thirds of the stomach have been removed.

Kocher over 20 ago years described the mobilization of the duodenum by dividing the peritoneal reflection on the right side. With the stomach mobilization depends largely on sufficient freeing the lesser curvature and William Mayo has emphasized the value of a high ligation and division of the gastric artery. Tension after the

A diagnosis of appendicitis was made. Abdominal incision exposed a healthy appendix. The small intestine was somewhat distended with an abnormal amount of clear fluid in the peritoneal cavity. A coil of the lower ileum was fixed to the back of the right broad ligament leading to a blue cyst like body in the substance of the broad ligament. The upper margin of the hernial orifice in the broad ligament was cut with scissors releasing 2 inches of ileum. The operator could now demonstrate that the pouch into which the intestine had passed was above the ovary and its ligament and that by the division of its neck it had been converted from a saccular pouch into a shallow fossa incapable of encouraging a similar retroperitoneal hernia. The operator did not think its obliteration by suture necessary.

The patient made an uninterrupted recovery.

#### TREATMENT

Treatment resolves itself in cases which develop acute obstruction into the release of the incarcerated intestine and the obliteration of the sac or fenestra. In Fagge's first case a large pouch was closed by suture. Several months later when the abdomen was reopened it was noted that the hernial opening had remained closed. In his second case the fossa was so shallow that it disappeared when the constriction was cut. Hernias under the round ligament should be released by cutting the constriction and repaired as indicated by the condition found. When the intestine passes through an opening in the meso alpinx the tube may be resected if the patient is past the menopause. Or if pregnancy be possible the broad ligament may be cut below the fibriated end liberating the tube and permitting it to swing freely in the pelvis. I doubt the propriety of suturing the opening if it is large

as the blood supply of the tube may be impaired by angulation. It is desirable to perform these operations under local anesthesia when intestinal obstruction has occurred because of greater safety to the exhausted and prostrated patient and because of the 'negative abdominal pressure' which may be secured.

#### SUMMARY

- 1 Broad ligament hernias are extremely rare
- 2 The etiology of broad ligament pouches and fenestra is unknown
- 3 Congenital malformation or postnatal trauma may be the contributing factors
- 4 Hernias in the broad ligament frequently produce obstruction and this obstruction is the usual cause of symptoms and the necessity of intervention
- 5 These hernias more frequently occur in women who have borne children but may follow labor or may be found in primiparae
- 6 The fact that hernias in the broad ligament may cause disability or obstruction demanding surgical relief must be kept in mind

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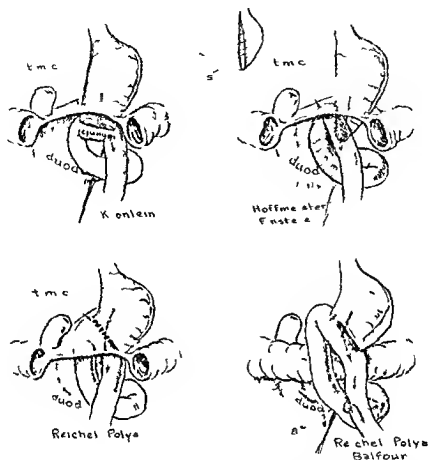


Fig. 2. More recent methods of partial gastrectomy. Koenlein method a low section of a narrow stomach was made and the small end of the stomach united to the side of the jejunum. This has been supplanted by the more radical Reichel-Polya and Hoffmeister-Finsterer methods in which care is taken to have the afferent loop of jejunum higher than the efferent. Hoffmeister-Finsterer method a large oblique gastric resection with removal of part or all of lesser curvature. Large retrocolic anastomosis with edge of lower part of gastric incision united to side of jejunum. Developed for gastric ulcer by Finsterer but considered by many surgeons unnecessarily radical. Reichel-Polya method an isoperistaltic retrocolic union of the end of the stomach to the side of the duodenum. Balfour's modification of the Reichel-Polya operation an isoperistaltic antecolic union of the end of the stomach with the side of the colon. Used to avoid the tension and technical difficulties of the retrocolic union particularly if the residual portion of the stomach is small and rather fixed. To avoid reflux distention of the proximal loop an entero-entero anastomosis has been added. T.M.C.—Transverse mesocolon. S—Stomach.

and burning. The fallacy of aptic operations upon the alimentary tract with a crushing clamp will be corrected as operators note the bacteria forced through the intestinal walls in culture.

In partial gastrectomy the late dangers and complications of an associated gastrojejunostomy should be eliminated if possible. Unless necessi-

tated by the character of disease a transverse resection so that peristaltic waves reach the end of the lesser and greater curvature simultaneously is desirable. Oblique resections with sacrifice of a disproportionate portion of the lesser curvature may as after Y-shaped resection of lesser curvature be followed by motor irregularity. In the

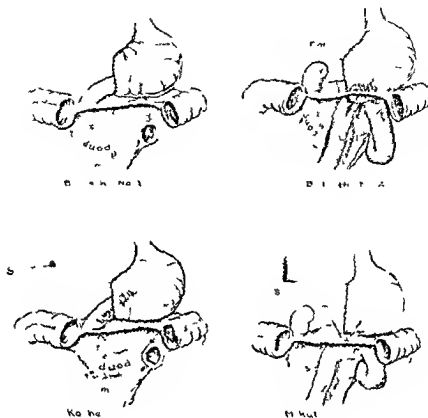


FIG. 1. Old methods of partial gastrectomy. Billroth I end-to-end union with duodenum anastomosed in lower part of gastric incision. With original technique this was followed by a kink at so-called fatal angle. The opening may contract and become occluded. Billroth II End of stomach and duodenum closed followed by separate anterior—or as before—a posterior gastrojejunostomy. Kocher method. A modification to avoid the fatal angle of Billroth I. End of stomach closed. End of duodenum anastomosed to posterior wall of stomach. Now practically obsolete. Mikulicz method designed to obtain dependent drainage. End of stomach joined jejunum and anastomosed to adjacent greater curvature. Rarely used. S—Stomach. T M C—Transverse mesocolon.

anastomosis may be relieved by bringing back over the line of suture the reflected peritoneal layer and tacking it to the anterior wall of the stomach so as to hold the gastric tarp well to the right. Much support also may be obtained by uniting the divided edges of the gastrohepatic and the gastrocolic omenta to their respective duodenal extensions and the line of suture in the serosa may be further reinforced by a covering of omentum. We have not seen separation of the suture lines from tension and with the use of proper mobilization and support it should rarely occur.

Altogether we would estimate that tension will prevent a safe end-to-end suture in less than

10 per cent of patients after partial gastrectomy. Secondary closure of the anastomotic opening has occurred after gastrectomy by the Billroth I method and after various forms of gastro-enterostomy. It is our opinion that in the former operation it has depended largely on the failure of the surgeon to use the maximum opening that the duodenum permits. The use of clamps which tend to fix the diameters of the stomach and duodenum as well as to devitalize the walls may be blamed for some of the limitations that have marked the new opening. The fires of medieval surgery are still alight for those who would divide the stomach only by strangling, crushing,



Fig. 4. Telescopic anastomosis showing adaptations of the method that may be used in end-to-side, side-to-side, and end-to-end anastomoses of the stomach and bowel. 1. Only a type of gastrectomy with telescopic union. The gastric mucosa is resected to a higher level and the redundant seromuscular cuff has its inner denuded surface applied to the serous coat of the jejunum around the stomach. 2. Anastomosis shown in cross section. The edge of the jejunal opening is united to the gastric mucosa at 2 and 3. The denuded seromuscular cuff of the stomach is shown partially surrounding and attached to the outer wall of the duodenum at 1 and 4. 1. Modification of telescopic anastomosis after partial gastrectomy with reduction in the functional capacity of the stomach by extensive resection of the gastric mucous membrane. The gastric mucosa has been removed from within the dotted lines; the duodenum invaginated into the upper angle united to the mucous membrane of the stomach; the mucous closure completed to the greater curvature and the redundant seromuscular coats of the stomach apposed by internal or by mattress sutures. 2. Similar telescopic modification of the duodenum at the lower angle of the incision.

between the edges of the abdominal incision to prevent postoperative hernia. The duodenum is thin and easily torn and approximates in thickness the mucous layer of the stomach. The smallest circumference of the stomach the inner is apposed to the largest circumference of the duodenum the outer. The telescopic union

therefore has the advantage of strength reinforcement and mechanical adaptation. The depth of invagination is from 2 to 6 centimeters and varies with the available length of the duodenal stump and the amount of stomach resected.

**Technique.** Through a convenient incision the abdomen is explored; the lesions determined and



Fig. 3. Partial gastrectomy with end to end union with expedients for producing a large stomach. 1 Port on of stomach to be resected. 2 End of duodenum stretched to produce direct end to end union. We have found this entirely feasible in a number of cases. 3 Superior or inferior edge of the duodenum split to form a large duoderal opening for direct end to end anastomosis. 4 Telescopic anastomosis with the puckering of the stomach exaggerated in the picture. 5 Telescopic anastomosis section showing the type funnel-like stomach produced.

anastomosis the lines of suture should of course be strong and well reinforced. For over a year we have employed a method of telescopic anastomosis.

#### TELESCOPIC ANASTOMOSIS

The method of telescopic anastomosis to be described has been used in ten cases nine times for ulcer and once for ulcerated carcinoma of the greater curvature. One patient died from post operative hemorrhage. The post-operative history of eight patients has been satisfactory.

Instead of an end-to-end junction of stomach and duodenum the duodenum is turned into the open end of the gastric stump after a high resection of the gastric mucous membrane and the outer serous surface of the duodenum united to the inner surface of the denuded muscularis of the stomach. The entire thickness of the cut end of the duodenum is united to the gastric mucosa. The superior strength of a union between muscle and peritoneum was observed by some of the early abdominal surgeons who after experimentation interposed peritoneum

meters distal to the proposed line of duodenal division stretched across and united to the posterior musculo-eros edge of the open stump of the stomach by means of guide and continuous sutures (Fig 10). Before introducing the continuous suture the relative breadth of the stomach and duodenum at the suture line is noted. If the former is three times as wide as the latter, it is obvious that the bights of the continuous suture should be spaced three times as far apart on the gastric as on the duodenal side. This rule is to be observed throughout the anastomosis. The introduction of several preliminary spacing sutures is helpful. The lower section of the stomach is now removed by dividing the duodenum along line three. Absolute haemostasis on the duodenal side having been obtained the remaining soft clamp on the stomach is gradually opened and bleeding vessels ligated when the clamp may be removed or reapplied at a higher level. The next step is to turn the free end of the duodenum into the open end of the stomach and unite it to the edge of the gastric mucosa. In this step also guide and spacing sutures will aid in the proper introduction of the continuous suture. These sutures pass through the entire thickness of the duodenum and the mucosa of the stomach (Figs 11 & 13). An intermediate row of interrupted sutures to unite the outer surface of the duodenum and the inner surface of the exposed muscularis

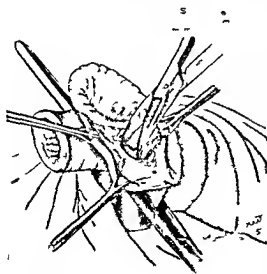


Fig 7 The gastric mucous membrane is being separated from the muscular coat by curved Mayo scissors.

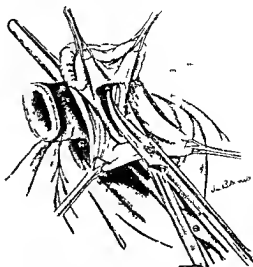


Fig 8 Telescopic gastrectomy continued. The separated cuff of gastric mucous membrane is divided on the line formed by the proximal clamp.

of the stomach is usually desirable to obliterate the dead space and control oozing. The anterior edge of the mucosa of the stomach is now united to the anterior edge of wall of the duodenum finishing this continuous suture after which the intermediate interrupted and external continuous suture lines are completed on the anterior face of the anastomosis (Fig 14). The operation telescopes a section of the duodenum 2-4 or more centimeters long within a section of stomach denuded of its mucous membrane. The entire thickness of the duodenal edge is united edge to edge with the gastric mucosa and surrounded by the thick musculo-eros coat of the stomach. Thus the duodenum which often is thin rather fragile and easily lacerated by sutures has a wide reinforcement by the thicker and tougher gastric wall. We have used No. 00 or No. 0 chromic catgut for all sutures. Obviously from the elasticity of the tissues the cuff of mucous membrane resected from the stomach may be much longer than the invaginated portion of duodenum. If desired the shape of the sero-muscular cuff may be modified as by making a long posterior and a short anterior flap. Properly performed the telescopic anastomosis produces a union with little wrinkling or external evidence of redundancy. The larger gastric end fits about the duodenum in a surprising smooth and accurate way (Fig 15). Viewed from the inside of the stomach on the cadaver (Fig 16) the normally



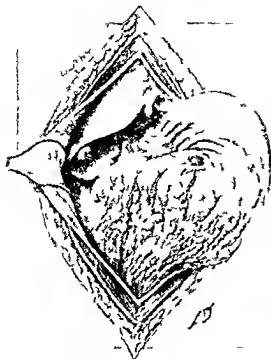
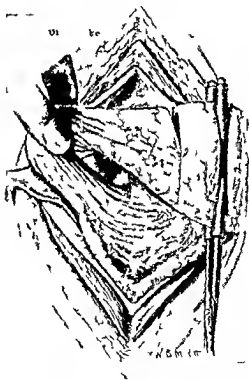


Fig 5 Ulcer of the anterior wall of the stomach attached to and invading the liver. Case 9

the operation planned. In the gastrectomy three lines of division of the alimentary tube are selected their position depending upon the pathological conditions that are found. The first is a transverse line across the stomach well above the area of disease where the mucous membrane is to be divided. The second line parallel with and 2 to 7 centimeters below the first is where the outer layers of the stomach are to be divided. The distance between lines one and two is the depth of the proposed invagination of the duodenum into the stomach. Line three lies below the area of disease and indicates the plane for the division of the duodenum.

The stomach and upper duodenum are liberated in the usual way. The peritoneum over the duodenum is divided near the pylorus and reflected to the right the upper duodenum freed usually to the pancreaticoduodenal angle with very careful ligation of all bleeding points. Adhesions to the pancreas and other tissues and the vascularity of the region may render this part of the operation troublesome. In freeing the lower end of the stomach the gastrohepatic and gastrosplenic omenta are divided between ligatures to a plane at least 1 centimeter above line one. The stomach

and duodenum having been sufficiently mobilized and all bleeding arrested by ligatures a soft or rubber-covered clamp is placed across the stomach just proximal to line one and a second clamp just distal to line two. After suitable isolation by pads the stomach is divided proximal to the second clamp (Fig 6) and the mucosa removed from the open proximal part of the stomach up to the level of clamp one. If there has been no preceding gastritis in this zone the mucosa will be found lightly attached to the overlying muscularis from which it is easily separated and removed by a pair of Mayo scissors (Figs 7-8). If adherent the mucous membrane may quickly be removed up to the line formed by the first clamp, by a large sharp bone curette (Fig 9). The pyloric segment of the stomach is reflected to the right and the left serous face of the duodenum several centi-



Figs 6 to 10 Telescopic gastrectomy. Figure 6 shows the stomach and duodenum have been liberated and all divided vessels secured by ligature. A rubber-covered clamp has been applied to the stomach on the line of proposed mucous membrane division and the stomach divided several centimeters below this point. A clamp to avoid leakage may be applied to the lower segment of the stomach which is reflected to the right.

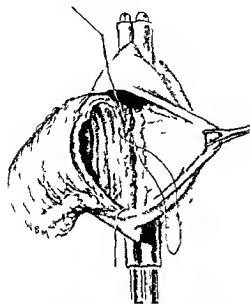


Fig. 11. Union of the edge of the duodenum to the edge of the mucosa of stomach by continuous suture. First row of sutures introduced. Interrupted guide and spacing sutures not shown.



Fig. 12. Edge of duodenum partially united to edge of mucosa of stomach. Interrupted guide and spacing sutures shown.

The operation was in a distant city and the wound was closed with a small gauze wick and with sufficient search for an oozing point. Then my bad advice prevented the local surgeon from reopening after I had left until the patient was in extremis.

With low acid values or offensive gastric contents we administer dilute hydrochloric acid before the operation and inject a 0.5 per cent solution through a hypodermic needle into the stomach and duodenum before opening the viscus. This we believe reduces the chance of infection.

**CASE 1.** Duodenal ulcer with subacute perforation to pancreas. Gall stones in appendix. Telescopic partial gastrectomy, appendectomy. Recovery.

Mr. Daniel, referred by Dr. J. M. Cunningham, age 35. Patient was anemic and had had digestive symptoms for 2 years with marked increase in symptoms for the past 3 months.

**Operation May 2, 1924.** Spinal anesthesia was used—6 centigrams of alcoholized stovaine through the twelfth dorsal interspace reinforced by 0.5 cubic centimeters of 1 per cent adrenalinized procaine injected locally. A duodenal ulcer with subacute perforation and dense adhesions to pancreas was found on the posterior wall of the second portion of the duodenum. The pylorus was almost occluded. There were faceted gallstones in the appendix, one 1 centimeter in diameter and six about 3 millimeters in diameter. A partial gastrectomy with telescopic resection was carried out with three rows of No. 0 and No. 00 chromic catgut sutures. The operative difficulties were

greatly increased by the adhesions to the pancreas. The appendix was removed. The patient's recovery was uninterrupted and December 1925, he reported that he was eating everything and free from gastric symptoms. At this time he was thin and showed evidence of pulmonary tuberculosis.

**CASE 2.** Gastric ulcer of lesser curvature with subacute perforation. Telescopic gastrectomy under local anesthesia. Recovery.

Dr. D. J. C. referred by Dr. Louis Branton, age 45. Dentist, a previous alcoholic, had suffered from digestive disturbance for 3 years.

**Operation June 19, 1924** under local anesthesia with 600 ml of 1 per cent adrenalinized procaine. A Perthes incision was made. A gastric ulcer with a crater measuring 2 by 1 centimeters was found on the lesser curvature of the stomach near the pylorus that had penetrated the muscular coat and was covered by adherent omentum. The first part of the duodenum and about one fourth of the stomach were removed, the duodenum being first divided. A modified telescopic union with a long posterior and short anterior flap was used with continuous and interrupted sutures of fine chromic catgut. The tissues were very vascular and friable. A hematoma requiring drainage developed in the abdominal wound and a postoperative cough was followed by an incisional hernia. The gastric symptom has been relieved by the operation (January 1926).

**CASE 3.** Multiple gastric ulcers, diffuse gastritis. Partial gastrectomy, appendectomy. Relief for one year only.

Mr. David S., age 38, referred by Dr. Wm. F. Robertson, fell from a box car November 1923 striking the sternum. Sores over lower sternum followed, succeeded by burning in the epigastrium and in February 1924 by nervousness and inability to work. The tonsils and adenoids were removed in March 1924. Gastric symptoms with much sour belching began in January 1924, beginning 1 hour after meals and radiating from the epigastrium to the back, increased and the patient finally could eat only ice cream with comfort and

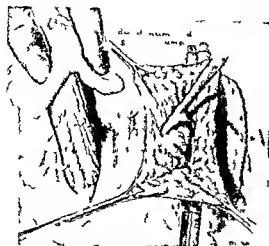


Fig. 9 If the gastric mucosa is adherent it may quickly be removed by a large sharp bone curette. The soft clamp applied to the stomach causes the mucosa to be divided by the curette along a straight line.

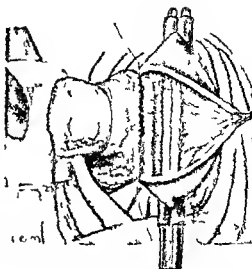


Fig. 10 Showing edge of mucous coat of the stomach and protruding deaused muscular coat. Posterior or sero-muscular suture in place.

plicated mucosa of the stomach fits well with the duodenal edge and a smooth funnel like opening from the stomach is formed with a large lumen.

The union is reinforced by uniting the gastro-hepatic omentum superior to the line of anastomosis and the gastrocolic omentum inferior to the line of anastomosis to corresponding peritoneal and omental reflections of the duodenum in this way covering the pancreas and closing the lesser peritoneal cavity. The portion of the peritoneum reflected to the right in mobilizing the duodenum usually can be brought over the line of anastomosis and tacked to the anterior wall of the stomach to aid in holding the stomach well to the right (Fig. 17).

As an excess of gastric mucosa is removed the operation produces the effect of a higher gastric resection upon the gastric acidity. With many adhesions about the duodenum or a very fixed duodenum the operation is tedious and difficult and in certain cases should not be attempted especially by the tyro in gastric surgery. Variations of the method may be used for gastro-enterostomy, other forms of gastrectomy and to reduce the functional capacity or acidity of the stomach as indicated in Figure 4. In the ten cases here reported an anastomosis of the type shown in Figure 3, A was used in nine, a long posterior and short anterior flap in one.

Hæmorrhage should be absolute. In mobilizing the duodenum every bleeding vessel should immediately be ligated. Care should be taken in the first posterior row of sutures that the pancreatico-

duodenal artery running in the groove between the pancreas and duodenum is not transfixed. Serious bleeding may follow a needle puncture of this vessel. Exposure or resection of parts of the cortex of the pancreas as a rule is harmless. In several instances we have divided the duodenum first and placed the posterior row of sero-muscular sutures before resecting the stomach (Fig. 18, 19). An objection to this is the damage that may occur to the line of suture in resecting the mucous membrane from the stomach.

**Anesthesia.** One patient received local anesthesia supplemented by a little ether. Nine of the ten patients received spinal anesthesia. As the duration of spinal anesthesia is only 60 to 90 minutes it was supplemented in 8 cases by local anesthesia with procaine adrenalin and in one case by 4 cubic centimeters of ether. The 200 cubic centimeters or more of the local anesthetic solution used not only reinforced and extended the action of the intradural injection but also stimulated the patient and protected the vaso-depression from the root anesthetic. All of the patients were more or less narcotized by preliminary scopolamine morphine injections. In one patient a thyrotoxic crisis resulted from the use of adrenalin in the local anesthetic solution. Three of the patients had gastric ulcer, six duodenal ulcer, one an ulcerating carcinoma of the stomach. A small cigarette drain was used in three cases on account of oozing surfaces. I am entirely responsible for the fatality of the series.



Fig. 15. Completion of sutures uniting outer layer of stomach to duodenum.

being increased by food and without vomiting. The x-ray showed a large 6-hour gastric residue and deformity of the duodenal cap. The patient, pale, rather emaciated and with a coagulation time of 6.5 minutes. A blood transfusion was given October 29, 1914.

**Operation October 11, 1914.** A vertical 14-centimeter upper right rectus incision was used. Spinal anesthesia by 6 centigrams of alcoholized novocaine in the twelfth dorsal interspace reinforced by local anesthesia with procaine and one third of a grain of morphine and a very small quantity of ether given to dull consciousness. The duration of the operation was 180 minutes. A recurrent duodenal ulcer with a crater 2 centimeters broad penetrating to the serosa was found in the posterior wall of the duodenum near the pylorus. The gall bladder was adherent at the site of previous cholecystogastrostomy, but the stomach had clotted. Adhesions were separated and the upper part of the duodenum and the lower one half of the stomach were excised and a telescopic union made with two rows of continuous interrupted sutures of No. 00 chromic catgut. An appendectomy was also done. The patient was discharged 19 days after operation and has had complete relief from all gastric symptoms up to last report made in January 1916.

#### CASE 6. Ulcerating carcinoma of the stomach. Gastrectomy. Recurrence.

Thomas L. minor, age 47, referred by Dr. W. P. Hall. Father and three brothers had pulmonary tuberculosis. The patient has had frequent rheumatic attacks. In October 1913 he developed pain one half to one hour after meals with weakness and loss of flesh but without nausea or vomiting. The attack lasted 6 weeks and recurred in May 1914 since which time it has been continuous. He has lost 18 pounds in the past year. There is increased resistance in the epigastrium.

**Operation November 7, 1915.** Spinal anesthesia by 10 cc. and local anesthesia with procaine reinforced by 1/2 ounce of ether and 1/6 grain of morphine and 1/100 grain of scopolamine. Through a 14-centimeter upper right rectus incision an ulcerating carcinoma involving the anterior wall and greater curvature of the stomach near the pylorus was found. The ulcer base dirty and sloughing, measured 2.5 by 4 centimeters; the ulcer edges were thick, indurated and irregular and nodules were found along the greater curve of the stomach and enlarged lymph nodes along the greater and lesser curves.

Two-thirds of the stomach and the first part of duodenum were removed with telescopic anastomosis by three rows

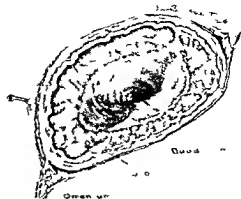


Fig. 16. Union viewed from within stomach after operation on cadaver. The large open funnel-shaped stoma is shown.

of sutures. The patient was discharged 14 days after operation and on January 19, 1916, he had continued free from symptoms and had gained 35 pounds. In September 1915 the patient died from metastasis of the cancer.

#### CASE 7. Duodenal ulcer with partial pyloric obstruction. Partial telescopic gastrectomy and appendectomy. Recovery.

Mr. Joseph L. referred by Dr. Arthur McGinnis, age 47, toolmaker, had typhoid at 30 years followed by dyspepsia with gassy eructations, colic and constipation. When 45 years old he had a gastric attack with pain under lower sternum relieved by food. Four months later the condition recurred and since then attacks have recurred at decreasing intervals. The pain has been constant for the past 3 weeks and is not relieved by food, although to some degree by soda. There has been no vomiting or passage of blood. Citrus fruits especially disagree. The patient has lived on liquids for 4 weeks and has lost 7 pounds. The gastric analysis shows much mucus and undigested food and the duodenal cap does not fill under the fluoroscope.

**Operation January 2, 1915.** A vertical upper right rectus incision was made. There was an ulcer on the anterior face of the duodenum just distal to the pylorus with pyloric narrowing. Adhesions were separated, the upper duodenum and lower end of stomach freed, and lower third of stomach and first portion of duodenum excised. The cuff of gastric mucosa was readily separated and removed. Four centimeters of duodenum were telescoped into the stomach with an outer serous and inner mucous row of continuous fine chromic catgut and an intermediate row of interrupted fine catgut sutures. The appendix had a thickened mucosa and contained fecal masses and was removed. The duration of the operation was 130 minutes. The initial blood pressure of 138-80 rose during the operation to 160-80. There was no wound complication and except for an attack of nausea and vomiting on the eleventh day, the postoperative course was uneventful. At last report, January 1916, the patient had remained free from gastric symptoms.

**CASE 8.** Marginal ulcer with hemorrhage following gastrojejunostomy for duodenal ulcer. Anastomosis disconnected, ulcer excised, openings in stomach and jejunum

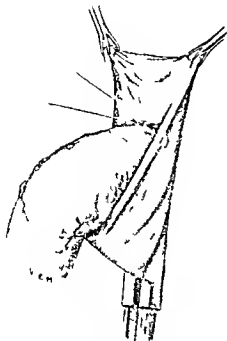


Fig. 13 Union of duodenum and gastric mucous membrane completed

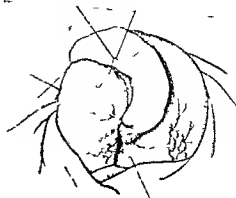


Fig. 14 Clamp removed to determine oozing or leakage along suture line. Anterior row of interrupted intermediate sutures uniting outer surface of duodenum and denuded muscular coat of stomach being introduced.

#### CASE 4 Recurrent hemorrhage from duodenal ulcer. Telescopic partial gastrectomy and appendectomy. Recovery

Mr. Charles A. age 35, electrician, referred by Dr. Rosen and Ohens. Eleven years ago the patient had hematemesis with epigastric pain. This recurred 8 years ago and bloody stools were noticed 4 months ago. Last month he vomited 8 ounces of clotted blood. The appetite has always been good without distress from food. The skin is pale and icteroid with moderate anasarca and puffiness of the face. There is some pyorrhea and gingivitis. The pulse is 110 and there is a mitral systolic murmur. The urine shows a trace of albumin and a few fine granular casts and cylindrical leucocytes. 3910 polymorphonuclears, 59 small lymphocytes, 3910 lymphocytes, 1 transitional, 1 hemoglobin 60-60, reds 3,600,000. Blood creatinine 1.5, blood chloride 3.62 milligrams. A blood transfusion of 300 cubic centimeters was given on September 9, 1944. The X-ray report is: large 6-hour residue with deformity of the duodenal cap.

**Operation October 9, 1944** under spinal anesthesia with stavane. Six drachms of ether were also used. A 14 centimeter upper right rectus incision revealed an ulcer of the posterior wall of the duodenum 4 centimeters from the pylorus with a crater measuring 2 by 2 centimeters. The lower third of the stomach and first portion of the duodenum were excised and a telescopic anastomosis made with two or three rows of fine chromic catgut suture. Primary union occurred and the patient was discharged 3 weeks after the operation. No recurrence of symptoms had followed up to June, 1945.

**CASE 5 Duodenal ulcer recurrent after excision, cholecystoduodenostomy and Fenn's pyloroplasty. Partial gastrectomy with telescopic union. Recovery**

Richard D. age 25, printer, has had gastric symptoms since 1914. In 1922 a duodenal ulcer with subacute perforation into the wall of the gall bladder of 2 weeks duration was excised with Fenn's pyloroplasty and cholecystoduodenostomy. This operation was followed by a severe intra-abdominal hemorrhage a day later a saphenous phlebectomy 6 months after this operation. The gastric symptom recurred with marked gnawing sensation in the epigastrium 2 hours after meals. Later the pain became continuous

lost 22 pounds. The abdomen was scaphoid without tenderness or rigidity. The X-ray report was: ulcer of lesser curve near the pylorus.

**Operation June 10, 1944** Spinal anesthesia by six centigrams of alcoholized stavane in the twelfth dorsal interspace with local anesthesia by 1 per cent procaine to finish the operation. An upper right rectus incision was used. The stomach contained a number of ulcers, one by 1.5 centimeters with step-like penetration into muscularis on the lesser curve midway to cardia, a second ulcer partially healed measuring 3 by 1.5 centimeters near the middle of the greater curvature, while several small ulcers with dirty greenish bases were found on the anterior wall near the greater curvature. The mucosa was very adherent to the muscularis and the removal of the mucous cuff by dissection was difficult. In this adherent type it was later found that a large curlette was very effective to rapidly remove the mucosa. A short cuff was formed the stomach being resected proximal to the ulcers, the upper border of the duodenum split to enlarge its opening and a telescopic union made with three rows of No. 0 and No. 00 chromic catgut. The appendix was removed. There was primary union and the patient was discharged on the thirteenth day after operation. Complete relief from gastric symptoms followed the operation until June, 1945, when the patient developed slight discomfort following food that has raised the question of residual or recurrent ulceration. The symptoms increased in intensity and January 10, 1946 the patient was asked to return for study and possible reoperation.

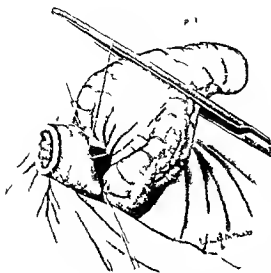


FIG. 18. Variation in technique with primary division of duodenum. (Cuffs for the continuous seroserosal suture being introduced.)

ulcer. The upper duodenum was freed from the adhesions and the lower fourth of the stomach and first part of the duodenum excised, and the duodenum telescoped for a distance of about 3 centimeter into the stomach with an outer and inner row of continuous fine chromic catgut and an intermediate row of interrupted catgut sutures. The cuff of gastric mucosa was easily separated and excised. The wound was closed without drainage. The duration of the operation was 140 minutes. The blood pressure 150-82 before the operation, soon fell to 132-60 from the spinal

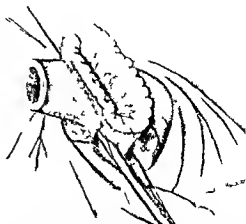


FIG. 19. Stomach divided after primary division of duodenum and seroserosal suture preparatory to removal of cuff of mucosa. This variation in technique was used in a number of the cases, but it was found difficult to remove the cuff of mucosa without damage to the line of seroserosal suture.

anesthesia, and then progressively rose as about 200 mls of 1 per cent procaine with 18 drops of adrenalin were given by local injection. At the completion of the operation the blood pressure was 206-100. The pulse 112 at the completion of the operation gradually increased in rate and in 48 hours the patient was restless and semi-delirious, the temperature 103.1 degrees F, the pulse 140, and it was realized that he was in a thyrotoxic crisis. Under refrigeration the symptoms rapidly cleared and the patient was discharged in April 1935. There was no wound complication, and thus far (January 1936) the patient has had complete relief from gastric symptoms. Recurrence of thyrotoxic symptoms followed by thyroidectomy in January 1936.

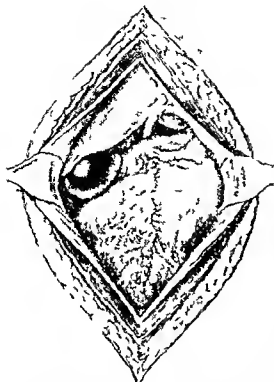


Fig. 17. Case 9 compl. tel. The openings in the gastro-hepatic and gastroduodenal omenta have been closed by fine ligatures relieving tension. The portion of peritoneum reflected from the duodenum has been brought back over the anastomosis and attached by several interrupted sutures to the anterior face of the stomach also relieving tension on suture lines.

closed. Telescopic partial gastrectomy secondary hemorrhage. Death.

Mr. John S., age 35, carpenter, referred by Dr. A. P. Butt. Gastric symptoms of several years duration for which a pyloric short loop gastro-enterostomy was performed in 1913. A few months after operation the distressing short time after eating recurred and in November 1914 the patient was almost exsanguinated by a violent hemorrhage from the stomach. The patient had a small anastomosis from this to the blood.

Operation January 1915 in West Virginia. Spinal to aine and local infiltration novocain anesthetic was used. Marked duodenal ulcer was found at gastro-enterostomy opening from secondary ulcer. A shallow ulcer about 15 millimeters in diameter was also found in the first portion of the duodenum. The stomach of ample size. The jejunum was disconnected from the stomach marginally. Excised the opening in the stomach and bowel closed and the lower fourth of the stomach and first portion of the duodenum excised with a less procedure to end anastomosis. Some oozing the hour of which was not easily determined was noticed that was apparently controlled by a small sponge introduced deep into the abdomen above the anastomosis. The pad was replaced by a gauze drain and

the abdomen closed. Duration of operation about 160 minutes.

Following the operation the pulse soon rose from 90 to 124 the patient vomited a small quantity of blood and believing there was oozing into the stomach I counseled delay. A small blood transfusion was given but the symptoms increased and 8 hours after operation the patient began to extremities. Dr. Butt reopened the patient during the course of the bleeding was located.

In this case I used poor judgment in attempting such an operation in a new environment and upon an anemic patient. A two stage operation would have been safer. The source of oozing should have been determined before the abdomen was closed. In a more recent case of oozing during the operation a puncture of the pancreaticoduodenal artery by the posterior row of sutures was found. The early postoperative shock should have been treated promptly by re-operation.

CASE 1. Duodenal ulcer perforating into liver. Telescopic gastrectomy and appendectomy. Recovery.

Mr. Julius K., referred by Dr. John B. Rarby, age 4, salesman, has had attacks of indigestion for 15 years. Formerly these attacks occurred during the Spring and Fall and lasted about a week with food ease and no gastric pain. For a month the pain has been almost constant without relation to the type of food and without relief after eating. Periods of severe pain referred to the lower anterior chest preventing work occurred both day and night.

Operation March 1, 1915. Spinal anesthetic by alcoholized at same 6 cent grams in the first lumbar interspace reinforced by local anesthetic with procaine. An incision was made. Operation revealed an ulcer of the upper anterior wall of the duodenum close to the pylorus that had invaded the inferior surface of the right lobe of the liver.

FIG. 18. Telescopic gastrectomy was performed with three rows of No. 00 and No. 00 chromic catgut sutures with removal of first portion of duodenum one fourth of stomach and a small portion of adherent liver. The appendix was removed and the defect in the liver sutured. The duration of the operation was about 100 minutes. Pulse at the close of the operation was 100. There was an uninterrupted recovery and the patient was discharged from the hospital on the fourth day. One and one half months after operation the patient continued to have complete relief of symptoms and had gained 10 pounds. In excellent condition January 1916.

CASE 2. Duodenal ulcer with ulcer perforation of the head of the pancreas. Telescopic gastrectomy. Postoperative hemorrhage. Recovery.

Mr. Peter T., referred by Dr. H. F. Tye, age single, clerk. A tall lean man had complained of burning in the epigastric region for 3 years with hunger pain and food ease. Food usually gave a relief for 3 hours. He had a severe attack of indigestion at Christmas 1914 when he was unable to work for 4 days. He had a severe attack but has not appeared in the past 3 years. There are symptoms of adenoma of the left lobe of the thyroid the size of small plum. On X-ray examination the stomach empty 5 hours the duodenal cap does not fill and an ulcer is in the first portion of the duodenum is diagnosed.

Operation February 20, 1915 through an upper right rectus incision a wedge shaped area of the posterior wall of the lower part of the first portion of the duodenum adherent to the pancreas the head of the pancreas forming the base of the



Fig 3 Case 3 Biceps motor During the pose the patient worked his motor

present 3 cases in which patients maimed in the arm were later provided with prostheses for two-motor stumps (bimotor) which were made from the biceps and triceps. These patients are at present going about their usual businesses.

Hence kineplastic amputation of the upper limbs maintains the great interest the subject inspired from the beginning and all my enthusiasm is at present directed toward securing by means of kineplastic motors an artificial hand lively and mobile, similar to the natural one.

A stump with two motors a bimotor answers the purpose best as the muscular activities of both motors are controlled and exercised analogously when one motor bends or contracts the other lengthens or expands as in the normal hand. This is shown in the 3 patients for whom arm stumps with two motors were provided one motor is controlled by the biceps and the other by the triceps the former motor situated on the front surface of the arm and the latter on the back surface the first flexor and the second extensor, each antagonistic to the other in action but in permanent tension or mutual action when they are mounted on their corresponding prostheses (Figs 1, 2 and 3).

A kineplastic stump with a single motor a unimotor is consequently inferior in efficiency and result to a bimotor stump since the antagonistic motor must be replaced by a spring and the substitute is incomparably inferior in action to a

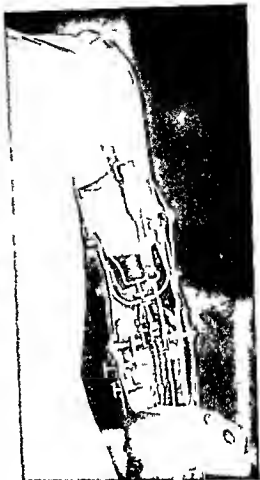


Fig 4 Prosthesis Sauerbruch furnished to patient

muscle with its varied and multiple manifestations of power the latter being voluntary and active while the former is purely and simply passive mechanical static immutable and permanent.

An amputation stump which can be provided with two motors affords us therefore two forces of great potentiality. This is particularly true when amputation has been done in the lower two-thirds as it places at the orthopedist's disposal the entire biceps and triceps muscles.

The technique which I use includes the making of a skin bridge or Pellegrini. More satisfactory results are found when this operation is carried out on the upper arm than on the forearm for the skin of the upper arm is looser and more elastic because the subcutaneous cellular tissue is yielding and supple. This facilitates the formation of



## KINEPLASTIC AMPUTATIONS ARM-BIMOTOR AND A PROSTHESIS

BY DR GUILLERMO BOSCH ARANA BUENOS AIRES ARGENTINA

Professo Faculty f Medice M mber f th Fac lity f th L w r s t y f Chief S g f P m o l l o s p i t a l

THE study of the kinematization of amputation stumps has a special interest for it arouses in the mind of all surgeons the natural desire to rehabilitate the maimed by supplying the lost limb. The ideal in the problem of the mutilated is to give to the artificial limb the power to function completely—the ideal in every operation being to provide for the complete substitution of any organ be it kidney, artery or joint.

As far as mutilations are concerned the tendency in kineplastic methods is toward the new physiological surgery or functional surgery in which kinematized muscles move the prosthesis.<sup>1</sup> It is not claimed therefore that the limb should be replaced by a natural grafting process as has been attempted in the case of joints kidneys etc but that an artificial limb shall be fitted to

A g h t t u s m t h o d

a stump supplied with muscles which have been prepared to hold the prosthesis by perforation lined with skin. When the prosthesis is adjusted these muscles transmit movements at will.

The grafting of a natural limb to replace a mutilated one is a problem foreign to kinematization of the limbs. This latter seeks the solution of a problem correlative with the present advance in surgery and the art of prosthetics. Kinematization is an original and very reasonable branch of surgery which is closely associated with orthopedics.

In an earlier publication (1) I presented reports of cases of patients maimed in the forearm for whom I had succeeded in obtaining excellent practical results. At that time I compared kineplastic amputations of the forearm with the radiocubital pincers of Krukenberg Putti (4). In SURGERY GYNECOLOGY AND OBSTETRICS in 1923 I described a kinematic prosthesis which I believe is original with me and which provides a very satisfactory method of dealing with very short stumps of the forearm. I also described (2) a new process for the kineplastic disarticulation of the elbow demonstrating the desirability and advantages of such disarticulations. In this article I



Fig 1 Case 1 Double motor for forearm 1 biceps motor 2 triceps motor



Fig 2 Case 2 Showing the bimotor biceps and triceps.



Fig 3 Case 3 Bicep motor During the pose the patient worked his motor

present 3 cases in which patients maimed in the arm were later provided with prostheses for two-motor stumps (bimotor) which were made from the biceps and triceps. These patients are at present going about their usual businesses.

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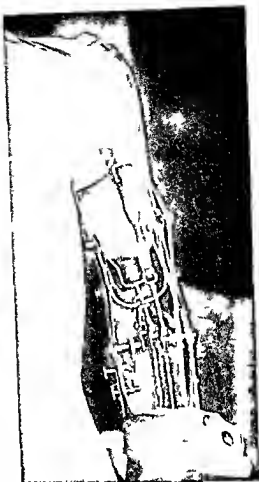


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Fig. 5



Fig. 6



Fig. 7

Fig. 5 Another prosthesis furnished to patient.  
Fig. 6 Bimotor with prosthesis 1 for flexion of elbow  
2 for rotation of the hand

Fig. 7 Flexion of elbow rotation of the hand and flexion  
or extension of the finger

ample large wide tunnels an admirable condition in that it favors orthopedic results and the best adaptation of the apparatus to be inserted in the tunnel or eye of the motor. As I have stated in a previous article (3) the larger the skin tunnel the better the adaptation of the motor to its prosthesis. Or in other words the power of the motor is better applied the greater the skin surface of the tunnel which is utilized in the transmission of its energy to the prosthesis. In any one of my 3 cases the finger could be inserted easily in the skin tunnel. With up-to-date technique the operation is simple and easy and may be done by anyone familiar with the usual operative practice. Sauerbruch has adopted this method with little variation (5).

Anesthesia may be local and infiltrative. For greater ease in the operation I have used Kulenkampff's truncular anesthesia which dissociates pain from muscular movement and makes it easier for the operator to choose the site of the tunnel through the muscle by taking it at its widest expansion or free action.

The skin is incised to form a bridge 5 centimeters long and 10 centimeters wide. The skin is freed with its surface aponeurosis and formed into a tunnel by means of a suture *en cartouche*. The muscle that is to be turned into a motor is sutured at

its farther extremity near the end of the stump on the fibrous scar of the old amputation so that the muscle may be left as long as possible and at the same time that there may be no extra hemorrhage when it is sectioned. The muscle is dissected and freed upward the muscular mass is sectioned in two frontal flaps one of which passes in front of the tunnel or skin bridge and is sutured to the other muscular flap behind the tunnel which is thus closed and clasped by the muscle motor thus formed. Hemostasis is secured and the edges of skin of the wound sutured directly. External dressing is applied. This operation is effected on both arm surfaces forming one motor with the biceps and the other with the triceps. A week later the stitches are removed a fortnight later gentle mobilization is effected and a month later active exercises are instituted which are gradually intensified and are carefully controlled and regulated by a nurse or a responsible skilful masseuse.

It is well to add that it is at this stage that the operation may fail for the patient wishing to gain time and to demonstrate his kinetic progress indulges in too strenuous an effort and brings on ulceration of the internal wound in the skin tunnel or else the muscular suture of the motor becomes torn. Ulceration of the tunnel heals

slowly and leaves a retractile nodular tissue which does not bear pressure as normal skin does the latter develops calluses with exercise the former produces cicatricial tissue which constantly becomes ulcerated

The motive efficiency of kinematized arms is marvelous re education being easy and inspiring easy because the flexion or extension of the forearm on the opposite side recalls at once the contraction of the biceps and triceps now kinematized and inspiring because it gives the impression of a resurrection of dead muscles—muscles which have been condemned as hopeless by all surgeons who have written on the technique of maiming operations of the arms from Celsus down to our modern and contemporary surgeons. In carrying out these kineplastic operations on the arm two very potent muscles are vitalized so that the orthopedist is provided with a biceps with power intact and a triceps no less potent

The result of the operation is all that could possibly be desired for the motors are perfect faultless. Their motor power is entirely active and the potency which you may permanently observe in these patients is the best proof I could offer you.

In one patient the construction of the motors was done in two operations. At the first operation the biceps motor was constructed 2 months later the triceps motor. In the two other patients kinematization was effected in one operation.

The two stage operation at intervals of 1 or 2 months makes it possible to secure more skin for the tunnels as the skin yields to the traction of the first operation. Kinematization is carried out with ease in a single session when the stump affords plenty of skin. The former process will ever afford greater guarantee of ultimate success.

The motors being prepared they must be used for the active movements of the prosthesis and thereafter the study of the kineprosthesis of the arms must be begun. The subject is a vast one and I shall endeavor to avoid analyzing it in a worn out fashion in this brief article. Therefore suffice it to state here that a good prosthesis should afford flexion and extension movements of the forearm (elbow joint) and furthermore flexion and extension movements of the fingers (finger joints) followed by supination and pronation of the forearm (hand) and flexion and extension of the wrist (carpus). These four movements are correlative and complementary and their order of importance or categorical diminution would be first flexion of the fingers

second flexion of the forearm on the arm third, pronation of the hand and fourth flexion of the wrist (carpus). It is well to note that with them are made practically the most useful movements of the principal articulations elbow, fingers wrist and ulna.

Many and various models of prostheses have been constructed but the one which at present enjoys the greatest favor is the one based on Sauerbruch's studies (5). The two kineplastic motors—biceps and triceps—are utilized in Sauerbruch's prosthesis for the daintiest and most delicate movements the opening and closing of the artificial fingers that is the grasping of objects. Flexion of the forearm is performed by means of straps and a shoulder piece attached to the shoulder while pronation and supination of the hand are controlled and executed by means of the contraction of the trapezius muscle of the shoulder. Flexion or extension of the carpus is absent in Sauerbruch's prosthesis but might well be effected by adding a simple mechanical appliance and be produced by bending the spinal column toward the side.

Sauerbruch's arm may be adjusted to any position to facilitate prolonged or continuous effort by means of a system of closure with mechanical tops which the patient puts on at will and thus he may freely hold an object between his fingers without tiring the motors controlling the opposite shoulder or the trapezius muscle which controls the working of the prosthesis.

Therefore it is evident that even if Sauerbruch's prosthesis is not absolutely ideal for it does not permit flexion of the carpus nevertheless it is a prosthesis which has great and practical advantages as the arm may be used freely for the necessary acts in the course of daily life and for compensating satisfactorily for the loss of the entire upper limb.

Before concluding I wish to state that three factors enter into the success of kineplastic amputations: (1) the surgical factor (2) the orthopedic factor (3) the factor of the individual or the patient. The first it may be unhesitatingly affirmed is well under control because the technique now used by surgeons is thoroughly efficient. The second at the hands of orthopedic engineers has been solved relatively but very satisfactorily as is shown by the Sauerbruch apparatuses. Lastly the third factor is the one which is the key to complete success depending as it does on the power of intellect of the will of the patient and on his ability to concentrate on his own re education.

## CONCLUSION

In conclusion I may say that my patients can grasp any object of average weight *lift it to the mouth or either side of the head bend the arm or extend it they can go through all the movements of pronation or supination of the hand necessary to hold objects or take articles and carry them to the mouth and raise the hand in complete abduction so as to form a right angle with the body* (Fig. 7).

In every one of these attitudes the fingers can take hold of an object or *it does not will through the kineplastic arm motors*. In a word we have an artificial upper limb the success of which depends entirely on the personal effort of the

patient in training and re-educating him self in its use

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## SUBASTRAGALOID ARTHRODESIS IN THE TREATMENT OF OLD FRACTURES OF THE CALCANEUS

By RUDOLPH S. REICH, M.D., CLEVELAND, OHIO  
F. M. B. O. H. T. S. C. M. S. H. O. P. A.

**A**LTHOUGH total disability very commonly follows fracture of the calcaneus the treatment of this condition has been on the whole unsatisfactory, and a rather careful search of available literature does not offer much assistance in the solution of this problem.

Cotton considers this disability due to an outward broadening of the calcaneus resulting from a lateral impaction of the peroneal plate and to growth of new bone behind it. He states that the external malleolus impinges upon the exuberant bone and causes pain by pinching the peroneal tendons when in motion. Lateral motion is limited and painful. The limitation is due either to the blocking of the posterior subastragaloid joint and to the fracture across it the fracture displacing the unbroken joint surface or shortening the slide or to new bone heaped up anterior to the malleolus. He suggests as treatment removal of all parts on the calcaneus and in more severe cases liberal excision of the impacted portion of the calcaneus beneath the external malleolus. This is followed by forcible manipulation—rotation abduction and adduction to remove all obstacles to normal motion. For cases of shortened and flattened heel with outward displacement he suggests cross sectioning the calcaneus behind the posterior portion of the subastragaloid joint and molding of the heel in a plaster-of-Paris-bandage.

Magnuson also considers the disability to be due to impingement of the peroneal tendon against the external malleolus and in addition to pronation of the foot and strain on the plantar fascia with loss of lateral motion. Treatment recommended by him is similar to that suggested by Cotton.

In the cases of disability following fracture of the calcaneus observed by the writer the findings do not substantiate those of Cotton or Magnuson in spite of the fact that these cases showed severe impaction and lateral displacement of the calcaneus in the region of the external malleolus with limitation of motion in the subastragaloid joint. This is the only type of fracture of the calcaneus which results in total disability.

When one considers the anatomy and function of the ankle joint he finds the astragalus articulates with the tibia and fibula forming the tibioastragaloid joint in which dorsal and plantar flexion of the ankle joint take place. Lateral motion in the tibioastragaloid joint is almost completely limited by the position of the external and internal malleoli on each side of the astragalus. Below is found the subastragaloid joint which is formed by the astragalus and calcaneus the function of which is to provide pronation and supination of the foot joint. The inferior extremity of the internal malleolus is slightly higher

than the subastragaloid joint whereas the tip of the external malleolus is slightly lower than the outer portion of that joint. Eversion and inversion of the ankle joint are performed in the mediotalar joint which is composed of the articulations of the astragalus and the scaphoid on the medial side and the calcaneus and the cuboid on the lateral side.

The cases seen by the writer have had but little limitation of motion and very slight pain on dorsal and plantar flexion except when the latter movement is carried to the extreme. Pain was then referred to the posterior portion of the subastragaloid joint. Lateral motion in the subastragaloid joint ranged from complete limitation in pronation and supination to approximately 25 per cent range of motion accompanied by severe pain on weight bearing. In fact the patients complained of as much limitation of motion in active and passive supination of the subastragaloid joint as in pronation. In other words in spite of the fact that there was an outward impaction of the fractured calcaneus there was but little limitation in dorsal and plantar flexion and supination was as painful and limited as pronation. A careful study of the roentgenograms in these cases reveals almost without exception fracture of the calcaneus into the subastragaloid joint and in addition often fracture of the inferior portion of the astragalus with it.

In rare cases there is also a fracture into the calcaneocuboid joint which obviously causes limitation in inversion and eversion of the tarsus and pain. Not infrequently the impaction extends posteriorly into the plantar surface of the calcaneus resulting in the formation of exostoses which are obviously very painful on bearing weight.

The author's deduction is therefore that the disability in these cases is not due as a rule to any impingement of the external malleolus and the peroneal tendons against the impacted portion of the calcaneus but is due almost invariably to a traumatic osteo-arthritis in the subastragaloid joint. The presence of spurs contributes to the disability.

The usual history given by patients afflicted with this condition is that they are able to get about with comparatively little disability when they walk on a perfectly smooth surface but when they walk on uneven surfaces they suffer severe pain in the ankle joint and fully as much in supination as in pronation.

As an illustration one of the writer's patients suffered a severely comminuted fracture of both calcanei extending into the subastragaloid joints

with the lateral impaction of the calcanei as described by Cotton and Magnuson. This patient had the usual severe disability in both ankles on weight bearing. He was fairly comfortable when walking on a smooth surface but suffered severe pain when walking on uneven ground. The roentgenograms showed that the left heel was more comminuted than the right. In due time there was almost complete limitation of motion in the subastragaloid joint of the left ankle. Coincidentally the pain and disability were almost completely overcome in the left ankle whereas the pain in the right ankle persisted. Accidentally he tripped on a rough surface broke up the fibrous adhesions that had formed in the subastragaloid joint, and the pain in the left ankle returned.

In view of these findings therefore the treatment obviously should be directed to immobilizing completely the subastragaloid joint and thereby arresting the traumatic osteo-arthritis present instead of breaking up these adhesions as recommended by Cotton and Magnuson.

In order to accomplish this immobilization arthrodesis is the procedure to be recommended. By this means one can limit pronation and supination of the foot. This operation was recommended by Davis and Ryerson and others for the relief of extreme paralytic valgus and varus deformities of the ankle.

The technique of this procedure is as follows: after a well fitting tourniquet has been applied to the limb a horizontal incision is made along the medial surface of the ankle joint beginning immediately posterior to the internal malleolus and extending around the tip anteriorly and slightly upward to the scaphoid bone. Care must be taken not to injure the tendon of the tibialis posterior muscle. Dissection is carried on through the soft tissues and the subastragaloid joint is exposed. By the aid of a chisel the cartilage of the posterior articulation of the calcaneus and the astragalus is carefully removed. In order that a complete arthrodesis be obtained another incision is made on the outer side of the ankle joint extending from a point immediately posterior to the tip of the external malleolus then under the tip and slightly upward to a point immediately superior to the cuboid bone at its articulation with the calcaneus. As on the inner side the dissection is carried on through to the periosteum care being taken not to injure the peroneal tendons. The subastragaloid joint will be found slightly superior to the tip of the external malleolus and the remainder of the cartilaginous surfaces of the joint removed. After the usual closure the

ankle is immobilized in a plaster of Paris cast extending from the toes to a point just below the knees maintaining a neutral position of the foot. If the fracture has extended anteriorly into the calcaneocuboid joint the outer incision is carried farther forward exposing this joint and the cartilaginous surfaces are removed. If the comminution has extended posteriorly and has resulted in exostoses on the inferior portion of the calcaneus they obviously should be removed.

The plaster cast remains for 3 months after which the patient is permitted to bear weight in a shoe with a well fitting longitudinal arch support. In addition the patient receives a systematic course of physiotherapy treatment in order to restore the dorsal and plantar flexion of the ankle joint.

The subastragaloid arthrodesis has been performed in four cases which presented the findings as previously described. The first case was operated upon in April 1924—the last in May 1925. Sufficient time has not elapsed for final judgment to be passed on this procedure. However the writer has had such gratifying results that he does not hesitate to recommend this form of treatment for the alleviation of this serious disability.

Although it is not within the scope of this paper to consider the treatment of recent fractures nevertheless the writer strongly urges the employment of the subastragaloid arthrodesis in those impacted fractures of the calcaneus in which the roentgenogram shows involvement of the subastragaloid joint. This should be done in addition to the treatment for recent fractures as

prescribed by Cotton and Funsten. It is more than probable that such a procedure would have to be carried out at some future time whereas if it were done shortly after the occurrence of the fracture it would result in a great economical saving particularly in industrial patients.

#### CONCLUSION

Disabilities resulting from impacted fractures of the calcaneus are due almost invariably to a comminution extending into the subastragaloid joint which results in a traumatic osteo-arthritis. Consequently there is severe pain on pronation and supination of the foot. The invasion of the fracture into the calcaneocuboid joint and into the plantar surface of the calcaneus causes exostoses which contribute to the disability. The treatment therefore consists in arthrodesis of the subastragaloid joint. If the calcaneocuboid joint is involved this also should be arthrodesed. If spurs are present on the plantar surface they should be removed. Subastragaloid arthrodesis has been performed on four cases and the results have been so satisfactory that the writer urges this treatment for this type of case.

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## AN OPERATION FOR INCONTINENCE OF URINE FOLLOWING PERINEAL PROSTATECTOMY

BY EDWARD L. KEYES M.D. F.A.C.S. NEW YORK CITY

PERINEAL operations usually prostatectomy that result in incontinence of urine leave a field for operative repair in which the surgeon has very little musculature to work upon. Dr. Young has reported relief of incontinence by suture of the internal sphincter from within the bladder, yet one cannot but feel that this operation would very frequently fail and would perhaps if it succeeded entail an unwelcome return of the retention of urine.

The operation to be described is offered as one that can always be performed without grave danger to the patient and without the least risk of bringing back obstruction at the bladder neck.

The operation was performed upon a man 70 years of age who following perineal prostatectomy a year previously had suffered from constant complete loss of control of urination day and night ever since. (A history of chancre in youth and mercurial treatment at that time led to the suspicion of cerebrospinal lues but normal reflexes and a negative blood Wassermann sufficiently ruled this out.)

The region of the prostate as felt by rectum was occupied by a hard nodular mass all across the pelvis and seemingly part of the perineal scar. Because of the hardness of this carcinoma was at first suspected. X-ray examination was negative.

The urine showed a few pus cells, a few hyaline casts, a good concentration (1:00). Phenol sulphonephthalein output was 20 per cent in the first hour, 20 per cent in the second. The systolic blood pressure was 128.

The patient's general condition was neurasthenic. He had sought vainly for relief at various hospitals and declared himself ready to commit suicide if he could not be helped. He had lost 40 pounds in weight.

The operation was performed on October 16, 1913. Through the usual V-shaped incision the perineum was opened in the line of the old scar and the rectum separated from the urethra. Incidentally the membranous urethra was opened so in order to insure a dry wound counter drainage was made suprapubically. Returning to the perineum the hole in the membranous urethra was closed with plain catgut. Some little dissection was done in the hope of finding some fibers of the external urethral sphincter but the membranous urethra seemed to be completely surrounded by scar and no muscle fibers were found. Indeed the only muscles in sight were the cut and scarred posterior end of the bulbocavernosus

the edge of the intact levator ani on each side and the rectum behind. Lacking any other method of bringing pressure upon the urethra it was decided to attempt to bring muscular pressure upon this by suturing together the two levators with the posterior part of the bulbocavernosus. This was very easily done after the bulbocavernosus had been freed from scar. The three muscles were brought together by three interrupted sutures of chromic gut. They made a muscular bed the bulbocavernosus holding the two levators forward snugly under the membranous urethra upon which the natural tension of the levators gave an upward tug.

The patient was in the hospital 2 days less than 3 months during which time he gradually gained weight (from 127 to 147 pounds) and courage. His suprapubic opening was permitted to heal 3 weeks after operation and for a week thereafter he had little control of his urethral muscles. Then he began to be dry at times and on November 25 (about 7 weeks after operation) he was for the first time dry all night but had passed his urine two or three times during the night. When he left the hospital on January 14, 1914, he was dry at night but was unable to control his urine by day except while sitting down. As soon as he walked about he complained of marked urgency and desire to urinate which if not heeded would result in incontinence.

This condition gradually improved until October 1924, 11 months after operation when he reported that he was perfectly well, still arose twice at night to urinate but could hold the urine half the day, had regained 30 of the 40 pounds which he had lost before operation and had no leakage excepting a few drops when he sneezed.

A month later he was shown at the New York Academy of Medicine and now in June 1925 he does not arise at night, he does not leak under any circumstances, he has not leaked a drop in several months.

This operation was performed on the theory that the difference between complete incontinence and complete dryness is not the difference between a wide open faucet and a tightly closed faucet but rather the difference between a faucet that drips very slightly and a tightly closed faucet. Consequently one may expect occasionally at least to close such a dripping urethra by relatively slight or indirect muscular pressure. The use of a sling made by junction of the edges of the levators to the bulbocavernosus is suggested as a means of providing such support of a firm and stable character and by means of an operation which seems relatively safe both in its immediate and in its ultimate consequences.



# TECHNIQUE FOR THE ROENTGEN DIAGNOSIS OF FRACTURES OF THE CLAVICLE

By FORTUNATO QUESADA M.D. LIMA PERU  
Professor of Orthopedics at the University of Lima

**W**HEN one follows the method ordinarily employed in the roentgen diagnosis of fracture of the clavicle which consists either in making one roentgenogram in the frontal direction centering the rays over the midpoint of the clavicle or in exposing two films according to the stereoscopic technique there are several important errors which may be committed.

In order to bear out this statement let us review three cases selected at random, in which we have been able to make a comparison of the X ray data with our operative findings.

In the first case (Fig. 1) stereoroentgenograms were made which in the stereoscope seem to show that superimposed upon the overriding fragments (a and b) there are two little shadows (c and d) which were interpreted as two small splinters. The roentgen diagnosis was: Fracture of the clavicle with two principal fragments and two insignificant comminuted fragments. When we operated on this patient we found the bone broken into five pieces, three of which we had not suspected either as to their size or their disposition (one of them 3 centimeters long by 1.2 centimeters wide we are preserving). We find ourselves very much dissatisfied with this diagnostic result.

The second case (Fig. 2) which we examined having fresh in mind the experience gained in the preceding case was quite similar. The single roentgenogram showed nothing more wrong than

the wedge shaped overriding ends of the two fragments (a and b) of the broken clavicle. At operation on this patient we again found the bone broken into five large fragments and three small ones. This was another roentgenographic error.

In the third case (Fig. 3) the film seemed to show a fracture of the clavicle without displacement—a green stick fracture. This impression proved even more inexact for simple inspection of the clavicular region and palpation of the parts showed frank overriding of the fragments. At open operation when we raised the flap we habitually employ in these cases we could see that the superposition of the fragments was very marked as is shown in the accompanying photograph of the operative field (Fig. 4). Once again we realized into how great an error we might be led by the classical roentgenographic technique.

How then in a case of clavicular fracture were we to determine exactly the number of the fragments, the direction of the line of fracture, the degree of overriding, the distribution of the comminuted bone, etc? In dealing with fractures of other long bones (humerus or tibia, for example) the details are perfectly well shown by films made at right angles for a phase not suspected in the anteroposterior film may be demonstrated easily in the lateral position or vice versa. If we desired to apply this principle to the study of the clavicle we would have to make one anteroposterior film



Fig. 1 Superimposed upon the overriding fragments (a and b) there are two little shadows which were interpreted as two splinters.



Fig. 2 Roentgenogram showing wedge-shaped overriding of the two fragments (a and b) of the broken clavicle.



Fig 3 Green stick fracture (Case 3)



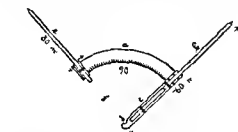
Fig 4 Photograph of operative field (Case 3)

according to the classical technique and (in view of the impossibility of making one in the lateral position) another vertical film shifting the focus of the tube above the shoulder and the film downward but this is difficult to accomplish. It occurred to us then to take advantage of the use of oblique projection of the rays and by taking pains to make the two roentgenograms with rays projected at right angles to find the equivalent of the two right angled planes of observation used with bones of the extremities the trunk and the head.

This we have succeeded in doing with great precision by means of an instrument (Fig 5) which consists of a quadrant of 90 degrees (a) with a perpendicular arm mounted at either end one (b) sliding in a tunneled support (c) which is further armed with a concave beak (d) to fit the contour of the clavicle the other arm (e) also sliding in a somewhat shorter tunneled support which can be moved the entire length of the quadrant and whose length is sufficiently reduced

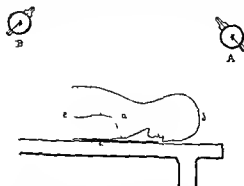
to permit it to be slipped along the quadrant over the shoulder however broad may be the opening (f) which it leaves.

The simple arrangement which we have devised is clearly shown in the accompanying sketch (Fig 6) the subject (a) to be examined is laid face down upon the table a film (b-b) is placed under the clavicular region (c) and the tube placed in the position A the rays centered parallel to the axis of arm b (Fig 5) of the apparatus and we make the first roentgenogram from above down that is from the head (d) obliquely downward toward the trunk (e). Then we change the film (or we may employ a large one dividing it into two parts covering the half not in use with lead, and center the rays from point B following the axis of arm e (Fig 5) of the apparatus and we expose the second roentgenogram from below upward that is to say from the trunk (e) obliquely toward the head (d). In making the first roentgenogram it is important to push the film a



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ALFO



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Fig 6 Sketch showing the patient on the operating table and the position of the instrument when it is in use

Fig 5 Adjusting instrument a Quadrant b perpendicular arm c tunneled support d concave beak e perpendicular arm f opening



Fig 7 Film secured by old fashioned method



Fig 8 Film secured by new method



Fig 9 Roentgen gram from below upward



Fig 10 Uninjured shoulder from above down



Fig 11 Uninjured shoulder from below upward



Fig 12 Roentgenogram made by old method

little bit toward the thorax and in the contrary direction in making the second one.

In the first case in which we tried this technique we worked with my friend the roentgenologist Dr. Eladio Lanatta the ninth of October 1924. We selected a patient who carried in his right clavicle a Dujarier clamp which served admirably

as a means of checking whether we had really succeeded in getting the two positions properly at right angles. It was also necessary to compare the results with those obtained by the ordinary technique. A preliminary roentgenographic study by the usual old fashioned method gave us a film (Fig 7) showing what seemed to be a satisfactory



Fig. 13 Stereorontenogram of case shown in Figure 12

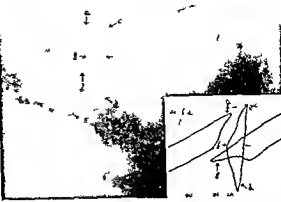


Fig. 14 Same case as that in Figure 12 with exposure by new method from above downward

approximation (a) with slight separation of the fragments (b and c) and the clamp (d) in an oblique projection. The roentgenograms obtained by our new technique gave very interesting pictures. In one of them (Fig. 8) taken from above down (tube position A Fig. 6) we see the clamp (d) in profile in all its details (bony union being conspicuous by its absence) anchored by one of its points to the internal fragment (c) and absolutely detached from the external fragment (b); the two halves of the clavicle widely overriding in the other (Fig. 9) taken from below upward (tube position B Fig. 6) we find the clamp in a position at a perfect right angle to that shown in Figure 8 recognizable only by one of the sides (its back) as forming part of an ideal bony approximation (a) giving no cause to suspect the marked overriding which we know exists. This latter film also shows the true curve of the normal clavicle.

One may then as we demonstrated before the Peruvian Surgical Society at its session of October 13, 1914 make roentgenograms of the clavicle in two positions at right angles as is done with other long bones which permit better study of the pathological roentgen anatomy of its fractures or other lesions and make a proper postoperative check up of the results. We have also demonstrated that the images produced are not distortions of the clavicular shadows. This is proved by the accuracy of the shadow of the clamp in Figures 8 and 9 and what is more important by the normal shadows of the clavicle on the uninjured side (Figs. 10 and 11) which show the characteristics of the clavicle as we are accustomed to see it in the classical anatomy of this bone. In the roentgenogram made from above down (Fig. 10) the clavicle appears with its lineal borders (a) as a straight

line such as this bone presents when seen in profile in osteology but with the film made from below upward (Fig. 11) we find the normal S curve which we should see when we observe the bone from either of its faces. We have recently operated on this patient to extract the disturbing metallic clamp which had become displaced and useless and we were able to verify the accuracy of our roentgenological conclusions.

The following case was selected by us to test the exactitude of a pre operative diagnosis made by our procedure because an open operation being indicated we would be able to realize *de visu* the operative anatomical and pathological demonstration. Naturally for comparison we made in advance an anteroposterior roentgenogram by the commonly accepted technique as well as a pair of stereoscopic films. The roentgenogram by the classical technique (Fig. 12) showed us an internal fragment (a) with beveled end and an external fragment (b) with a forked end—nothing



Fig. 15 Same case by new method from below upward

more. The stereoroentgenograms showed us (Fig. 13) the same fragments (*a* and *b*) and surprised us by showing that the external branch (*c*) of the fork was split off.

None of these roentgenological data explained the outstanding clinical fact which in this case necessitated operation: one could feel a very sharp bony fragment which threatened to perforate the skin in this region.

The two roentgenograms made at right angles by our technique gave us a more complete and logical result. In the first film exposed from above (downward) (tube position *A*, Fig. 6) we found (Fig. 14) a beveled internal fragment (*a*) markedly overriding the external fragment (*b*) which was also beveled but in addition a third loose fragment (*c*) long placed vertically with its outer border (*e*) straight and its inner border (*f*) convex with very sharp pointed ends (*c* and *d*) the upper point threatening to pierce the skin. The loose fragment was about 5 centimeters long by 1 centimeter wide. In the film exposed from below upward (tube position *B* of Fig. 6) we found (Fig. 15) the same fragments (*a* and *b*) overriding in the anteroposterior direction with their beveled ends somewhat obtuse and superimposed upon

them a very dense shadow (*c*) which was no other than that of the third fragment seen in its short diameter thus permitting us to appreciate its thickness and its location anterior to the principal seat of fracture. We were now able to make a complete roentgen diagnosis—one agreeing with the clinical observations. At operation when we lifted the flap of soft parts there was presented to our vision and to that of visiting surgeons (among them the Dean of the Faculty of Medicine Dr. Guillermo Gastaneta) a panorama of the zone of fracture exactly corresponding to the roentgenographic image of Figure 14: the two beveled fragments and the third fragment placed in front, directed vertically toward the skin and of the dimensions which we had calculated from the roentgenogram.

We have other cases in our series. At all events as was expressed by the surgeon and radiologist Dr. James T. Case on the occasion of his visit to Lima this original method which we present has undoubted advantages over the classical technique and presents the very great advantage over stereoscopy that one may have the films in the operating room in sight of the surgeon for his direct use during operation.

## ANASTOMOSIS OF VEINS

### A METHOD WITHOUT THE USE OF SPECIAL INSTRUMENTS

By CLARENCE F. BIRD, M.D., NEW HAVEN, CONNECTICUT

From the Department of Surgery, Yale University School of Medicine

THE method described for anastomosing veins was developed to provide a large reversed Eck fistula in dogs a stage in the procedure for the removal of the liver for experimental purposes as outlined by Mann (5). It may however prove of use in human surgery.

A large opening, the caliber of the portal vein or larger is essential for consistent success with the reversed Eck fistula. On first attempting the operation we used the method described by Bernheim, Homans and Voegtlin (1) which involved blind cutting with scissors. This method is satisfactory only for small fistulae and all our animals died within 18 hours.

Similar procedures such as using a cutting thread (3) or a fine cautery wire (6) instead of scissors were not attempted. The operation of Jeger (4) in which he uses special clamps to isolate a portion of each vein wall without inter-

rupting the blood stream appears to have much merit. It has however the disadvantage of requiring special instruments and it cannot be used on small vein. An operation was therefore devised by which with no special instrumentation a large opening could be consistently obtained.

#### OPERATION

A healthy animal is kept without food for 12 to 24 hours, it being desirable to have the stomach empty and the portal vein unengorged. An incision is made in the midline from the xiphoid process 15 centimeters toward the pubis in a dog of average size. In males the penis is undercut, it being inadvisable to leave the midline because many large veins important in establishing compensatory venous return after operation would be cut. Two moist wadding towels are now introduced deep into the abdomen. A self-retaining

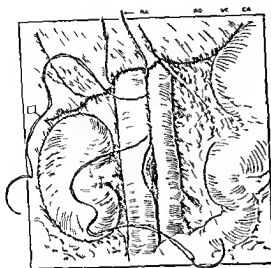


FIG 1

retractor is placed in position and the operator's hand is placed on the vena cava side with the assistant's on the portal side in such a way as to provide the exposure shown in Figure 1.

The method devised is similar to some types of lateral intestinal anastomosis. Further steps in the operation are described by illustrations and legend (Figs 1 to 7).

The operative field (Fig 1) is exposed by retraction of the liver stomach and duodenum and by division of the right hepatorenal ligament. By blunt dissection the portal vein is stripped of fascia, fat and lymphatics so that the tributaries are seen. A heavy braided silk ligature is threaded around the vena cava next to the liver reflexion. It is not tied until the anastomosis is completed. The assistant rotates the portal vein to the left and a posterior row of doubled C silk on a No 5 French needle is placed. It is important to stitch as far posteriorly on both veins as possible. The hepatic artery is buried progressively as indicated.

The posterior row of sutures is complete (Fig 2). It is from 3 to 4.0 centimeters in length depending on the size of the dog. Stitches to be used for the anterior row *F* and *F'* are tied into the knots at the ends of the posterior row.

The haemostatic suture *E* (Fig 3) is accurately placed beginning where the knot in the doubled thread is shown. The first and last stitches effectively close over the ends of the tuck raised in the portal vein. The vena cava is thick walled and needs only the closer placing to effect this purpose on its side. The spaces *B* should be

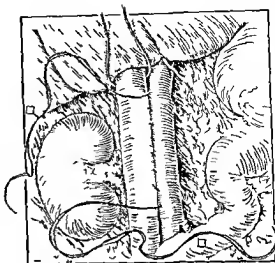


FIG 2

smaller than the portions covered by thread ensuring haemostasis. The space *C* in the portal vein should be as long as the space *D* in the vena cava. Otherwise there may be difficulty in cutting the top from the tuck in the thin walled portal vein.

The haemostatic suture *E* (Fig 4) is pulled tight from both ends. This is done before the last stitch of the haemostatic suture is taken in the portal vein and vena cava. After this last stitch is completed a tight pull suffices to lock the suture and the ends may be dropped. A single stitch of the anterior row *F* is placed at the upper end but is not tightened.

The assistant tightens and somewhat elevates the lower end of the haemostatic suture while the operator cuts off the top of the tuck first from the vena cava then from the portal vein. Smooth thumb forceps and curved scissors are used. An elliptical strip of vein from 1.5 to 4.0 millimeters wide and from 2.0 to 3.5 centimeters long is removed. The haemostatic stitch may again be dropped or if there is slight leakage at any point when unsupported held lightly.

In Figure 5 we see that each vein has been opened for a distance of from 2.0 to 3.5 centimeters.

In Figure 6 the haemostatic suture *E* is still in place. The anterior row of stitches *F* and *F'* is inserted from each end as a continuous infolding stitch. It is pulled up loop by loop from the vena cava side while the assistant makes use of invagination of the cut veins. The knot is tied and the ends are cut.

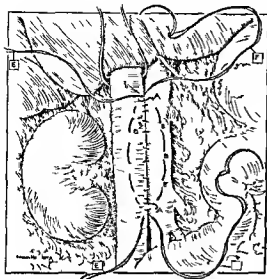


Fig 3

In Figure 7 the hæmostatic stitch has been care-fully withdrawn completing the anastomosis. The veins are now taken in the fingers and gently manipulated to make sure of thoroughly opening the fistula. Traction on the ligature around the vena cava before tying it causes slight engorgement of the portal vein and vena cava and a tachy-

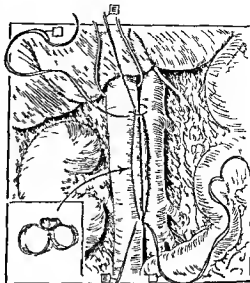


Fig 4

cardia of 120 to 160 beats per minute. The vena cava is tied off and the abdominal wall sewed up in layers. Many abdominal veins which did not bleed on entering the abdomen are now seen to ooze and there is marked engorgement. The larger bleeders are tied but interference with the venous return is avoided as far as possible. The

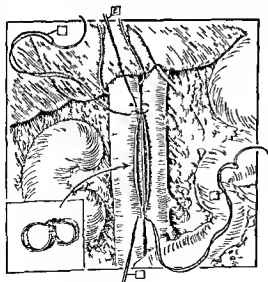


Fig 5

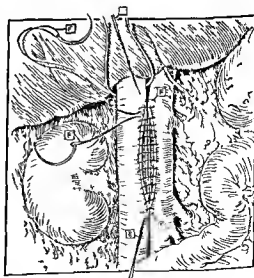


Fig 6



Fig 8

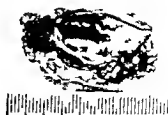


Fig 9

dog recovers from ether as the wound is closed and is in excellent condition. No special postoperative care is needed.

#### COMMENT

Several points in technique are important. As mentioned by Bernheim and Voegtlin (2) doubled silk should always be used, the two strands filling up the needle hole effectually. We have found too that oiling makes the silk slip through the vein walls more easily. In the continuous suture of veins each stitch should be put through the thicker walled vein last before tightening. This prevents tearing. If any point should bleed persistently a bit of muscle placed over it with the application of light pressure will stop it. If a needle breaks leaving the pointed half in a thin walled vein take another stitch close by continue sewing until ready to pull up then remove the fragment backward and tighten the suture.

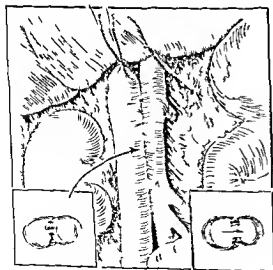


Fig 11

The main advantages of the method may be summarized in this manner:

1. No special instruments or specialized operative technique are necessary.
2. All steps are carried out deliberately under the direct vision of the operator.
3. The opening is oval, not linear.
4. There is no limitation within reason as to the length of anastomosis which can be made.
5. Veins much smaller than the portal of the dog may be anastomosed.
6. There is no puckering of vein walls with possibility of valve-like flaps or inclusion of tributaries as in methods which require a mattress suture for closing over the end of the anastomosis (2).

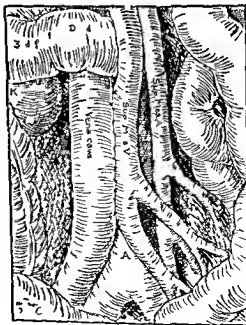


Fig 10



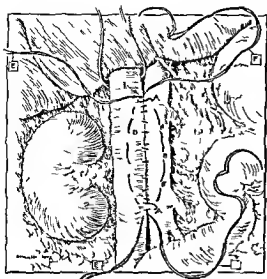


Fig. 3

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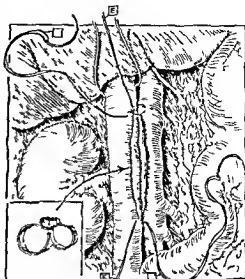


Fig. 4

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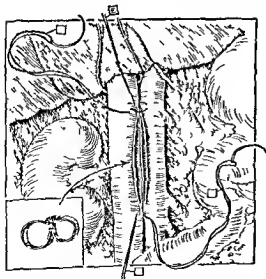


Fig. 5

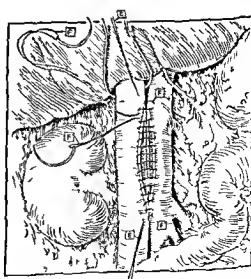


Fig. 6

# CORRESPONDENCE

## FINAL RESULTS OF OVARIAN GRAFTING

To the Editor I have read with much interest Dr W Blair Bell's article on Ovarian Grafting in the December 1935 issue of SURGERY GYNECOLOGY AND OBSTETRICS

The favorable results as mentioned by the author appear to me as extraordinary especially when I recall my own experience in ovarian grafting. Considering the marvelous results claimed by Dr Bell I have sometimes wondered if the technique I use is not defective but the more I compare Dr Bell's technique with my own the less I find any material difference between the two. I will describe the technique I use.

The ovarian tissue is carefully separated from the structures surrounding it. It is temporarily wrapped in a compress saturated with hot serum (40 degrees C) during the primary operation and until it is time to implant it. After the ovary is scarified it is carefully placed in a pouch produced by separating the peritoneum and the posterior face of the rectus. The peritoneum and the abdominal wall are closed with the ovarian tissue implanted in the extra abdominal pouch.

It was in Paris during the year 1916 that following the example of Tuffier I began to use this method of ovarian autografting. Since the war back in Canada I have used the method in 25 cases in patients who had undergone an operation for double salpingo-ovariitis without hysterectomy.

In the December 1923 issue of *L'Union médicale du Canada* I reported the results obtained as follows. In our experience while the results obtained in ovarian grafting have not been encouraging, on

the other hand the ovary grafted has never caused serious trouble and has apparently ultimately undergone sclerotic degeneration. In some patients (three) there was an absence of artificial menopause disturbances but such a condition was quite prevalent in patients in whom ovariectomy had been done without ovarian grafting. The menstrual flow would continue for some time when a few ovarian cells had been left intentionally or not in the pedicle.

And thus my experience leads to this conclusion that medical and surgical therapeutics have failed in cases of ovarian insufficiency brought about through ovariectomy that our knowledge of ovarian physiology is rather limited that though it is sad to admit defeat after such tenacious effort it is best not to court delusion any longer through the practice of insufficient methods but rather to try to find by working with physiologists some other means of dealing with the ovaries such as those we now use in dealing with the thyroid.

I may state as does Sauvè who has experimented in ovarian grafting that one cannot scientifically infer that anatomical integrity becomes physiological integrity.

To demonstrate the truthfulness of this statement I will describe briefly a case which I believe is conclusive. 'It is probably also the only case reported in the medical literature.

In September 1925 a patient upon whom I had operated 5 years previously (1920) for bilateral lesions of the ovaries and the adnexa came again to my surgical clinic. As I had made it a practice



Fig. 1 Sections of the ovarian tissue 5 years after a grafting. Section I A Stratum granulosum B theca C stroma D blood vessels. Section II A B D enlarged. Section III Stroma enlarged.



Figs 11 and 12

#### 7. There is no loss of blood and no shock

We have done eight of these operations on dogs varying in size from 9 to 20 kilos. Five were successful and examination at a subsequent operation showed functioning fistula in each case. Three dogs died because the edges of the fistula were not entirely separated 2 within 18 hours and 1 after a period of 5 days. These fatalities were due to the fact that the veins were not manipulated after withdrawing the hemostatic stitch. This is apparently a very important point and the manipulation should never be neglected. In the two dogs which died soon after operation the edges of the opening were close together and cov-

ered by a fine fresh thrombus along the entire extent of the vena cava side of the anastomosis. In the dog which died after 5 days only a portion of the anastomosis had opened and this had gradually filled up by a thrombus propagated from the part which had never functioned.

Figure 8 shows a specimen removed 18 hours after operation. The veins were opened, the anastomosis filled with gauze and the specimen fixed in formalin for 24 hours before photographing.

Figure 9 shows a specimen from a dog sacrificed one week after operation.

That the procedure may prove of use in human surgery is indicated by the fact that we were able to carry out the anastomosis of the inferior vena cava with the superior mesenteric vein in a cadaver. Figure 10 is a drawing showing the completed anastomosis and the important anatomical relations. Figures 11 and 12 are photomicrographs of the cadaver specimen showing the anastomosis from the outer side and from inside the vena cava. Anastomosis of the vena cava with the portal vein in the human being immediately comes to mind.

#### SUMMARY

A method is described for anastomosing veins. No special instruments are necessary and the procedure may be carried out rapidly and in direct vision with a assurance of a successful outcome. A large oval opening is provided.

I am indebted to Dr. Carlos M. Echandi, Yale School of Medicine, for assistance with the operating.

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# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D.  
ALLEN B. KANAVEL, M.D.

Managing Editor  
Associate Editor

WILLIAM J. MAYO, M.D.

Chief of Editorial Staff

MARCH 1976

### MESENTERIC VASCULAR OCCLUSION

THE subject of mesenteric vascular occlusion is involved in considerable confusion and on account of the high mortality little effort has been made to disentangle the diagnostic signs and symptoms of these accidents which involve the intra abdominal viscera. Embolus and thrombus of the mesenteric vessels are not infrequent accidents and are rarely diagnosed prior to the opening of the abdomen for operative or postmortem purposes.

In clinical diagnosis the first element of confusion is that many authors include embolus and thrombus as causes of intestinal obstruction without differentiation. It is true that they may cause obstruction. Another element of confusion is the difficulty of determining on the operating table whether the trouble is in the vein or the artery and whether it is from an embolus or a thrombus. Still another element of confusion is that so large a proportion of the reported cases are postmortem studies which never received surgical analysis during life. This difficulty has led at least one prominent writer to coin the

term 'mesenteric vascular occlusion' as sufficiently inclusive to fit all cases.

A study of the literature would lead one to conclude that surgeons coming on the condition unexpectedly at the operating table have not made much effort to trace back the clinical history for diagnostic signs and symptoms for future guidance. In fact a large proportion of these cases seem to have been considered as terminal conditions of long standing cardiovascular disease and they are not given serious surgical analysis. We must admit the difficulty of pre operative diagnosis yet the condition has very definite signs and symptoms especially in the more acute cases. The presence of an acute abdominal condition in a patient in which the cause cannot be made out and especially in one having well marked cardiovascular sclerosis should always put the surgeon on guard for the possibility of a 'mesenteric vascular occlusion'. While in embolus the insult is much more acute in thrombus the symptoms bespeak an increasing area of intra abdominal involvement extending over a varying length of time. The symptoms which involve only a vascular branch are necessarily different in both degree and intensity from an involvement of a main vessel. If prompt recognition of the condition which involves only moderate areas could be developed surgical intervention would yield good results. A review of the literature beginning with the exhaustive studies by Porter, Jackson and Quimby published in the *Journal of the American Medical Association* in 1904 and a few later writers shows serious attempts to secure a better basis of the causes signs and symptoms of occlusion of a mesenteric vessel.

## SURGERY GYNECOLOGY AND OBSTETRICS

at that time to transplant ovarian tissue in the abdominal wall this patient had undergone that treatment. But as in other cases the beneficial effects of the grafting had failed to materialize in fact I never have seen a castrated patient suffer so much as this one did by the complications of the menopause which had resulted.

This patient required a laparotomy for lesions having no connections whatsoever with the previous operation. I therefore grasped this unexpected opportunity to examine the grafted ovarian tissue and without complicating the operation I exposed the grafted ovary. This was an easy matter as we had the records of the operation done in 1920. The grafted ovary was found in its bed between the peritoneum and the posterior aspect of the rectus half way between the umbilicus and the pubis. By an incision extending beyond the limits of the entire organ the ovary and all the surrounding tissues were taken out including the smooth surface of the parietal peritoneum at the back and as far as the muscular fibers of the rectus in front. During this rapid intervention we were able to note that the organ had decreased by about half its volume within the 5 years. After incision the grafted tissue appeared enveloped in fibrous tissue on cutting the tissues we noted a vascularization extending as far as the arterial flow. The anatomical integrity of the transplanted organ was thus conclusively established. But we were not satisfied with these proofs and so we submitted the organ for histological examination to professors Hingston and Jutras. They reported that the sections showed ovarian tissue that there was a thick layer of large clear cells such as are found normally in true stratum granulosum that these cells rested on a fibrous theca that the stroma appeared normal that vascularization was good and that there were no signs of inflammation or degeneration.

It is thus evident macroscopically and microscopically that the grafted ovary in the abdominal

wall had secured good nutrition a relative autonomy and an anatomical integrity practically perfect in view of all the conditions required for a successful grafting operation.

I see no reason why similar results should not prevail in most of the cases in my series as the operations were done with scrupulous care according to the same technique in all cases.

How is it then that in this particular patient ovarian insufficiency persisted so stubbornly as it has in most of the other patients operated upon by me for ovarian grafting?

In my opinion the answer is simple ovarian grafting performed under present known conditions does not insure physiological integrity of the organ on the other hand it lives as a parasite carelessly and unconcerned as to its own internal secretion. All of this likely is because the nervous system which has a function to fulfill is not able to do so. Perhaps other physiological conditions of which we are still ignorant are lacking. At least this case is an example which teaches us the fate of grafted ovaries and it reveals as well very clearly the therapeutic inefficiency of ovarian grafting.

One must have the courage to confess experimental failures. It would be too good to be true if by a simple surgical process the artificial menopausal troubles could be mastered.

From our experience I believe we are justified in saying that ovarian grafting is not more beneficial than testicle grafting from monkey to man and having thus dealt so discouragingly with the subject of ovarian grafting let us try to seek anew with the co-operation of physiologists and chemists an efficient therapeutic measure to replace our present method.

PIERRE Z. RHEAUME

Professor of Operative Surgery  
University of Montreal and  
Surgeon Hotel Dieu

Montreal Canada

ization in position with or without regard to heat penetration quite a number of electrical principles of which endothermy is the newer one chemicals in several combinations radium with various plans of application introduction degree of dosage filtration time and frequency of treatment X ray, involving the same questions with penetration depth added Possibly in the future, serology may enter into trial With a host of clinical pictures on the one hand with an ever increasing group of agents on the other the question of treatment presents many phases

Surgery either as a primary effort or secondary to assist the introduction of destructive agents will always maintain a place in the care of internal cancer because in no other way can the situation be determined In external and accessible malignancy there is the inviting group for the study of the action of this great number of destructive factors

Primarily all methods are studied and advanced with the hope of an universal cure but it is apparent that the multiplicity of situation precludes any such answer at least with our present knowledge There is no single plan without very valid objections which are generally known There appears a tendency in recent years to use that or those of one in support of the use of the other a tendency to place the treatment of cancer on a competitive basis

Trial experience and accumulation of data are necessary to test the value of these plans and locate their use There is no question but what the study is activated by the highest motives but it is equally true that concentration on one line whether it be surgery or otherwise leads to use without due consideration of the case It may be an exaggeration to say that there is now a greater tendency than ever to apply treatment upon the blanket diagnosis of cancer

With all these things in mind the indications of the future point positively and directly to the effort to group conditions not only with exact study of the cellular picture but with regard to location and careful consideration of superimposed and extraneous influences Whatever pathologists may generally think of Broder's group, and it must permit of wide personal interpretation, nevertheless it presents a most important effort and may lead further in the grouping of cases in the consideration of plans for treatment

Will it not be an advantage to pause in our discussion of the relative merits of agents and consider that the whole question of treatment revolves around the choice of only two possible methods of attack excision on one hand destruction in position on the other Upon which procedure lies the greatest expectation of a cure?

All attempts at destruction in position are open to an important objection—uncertainty of accomplishment The result can be interpreted only by appearance The possibility is ever present that activity is only arrested and not completely inhibited The end result is contraction or scar formation of once diseased tissue remaining in place All attempts at excision may end in loss of function or a cosmetic deformity Such result is the most fearful In fact it appears that fear of surgery and its scars is the most potent factor in causing the greatest handicap in the treatment of this disease—delay in seeking advice The surgeon is also influenced with an estimable desire to leave a minimum scar to make a close instead of a wide excision

Whether it will ever be possible to agree generally upon the relative merits of the primary procedures whether it will ever be possible always to recognize their limitations or formulate plans for their use in combinations it is nevertheless true that the objec-

To be able by analysis of the cardiovascular history and the immediate signs and symptoms to determine the nature of the intra-abdominal insult does not end the problem as far as the surgeon is concerned. In at least one case studied after the abdomen was opened the surgeon was able to decide after watching the circulation for a short time that the badly discolored intestine was already beginning to improve under its collateral circulation. Possibly the temporary relief of intra-abdominal pressure while the abdomen was open may have contributed to the favorable outcome. The abdomen was closed without operative interference with the intestine or mesentery and a good recovery followed.

Immediate recovery does not end the patient's danger. The impairment of the intestinal circulation and the large amount of transudation of bloody serum through the peritoneal surfaces may lead to subsequent multiple obstruction from mass adhesions. In one such case it was necessary three years after the attack to anastomose the ileum into the descending colon.

With improved methods of operation and especially with the development of safer anesthetics and technique of inducing anesthesia these cases can come to operation early with greater assurance of success. Such cases furnish a fertile field for clinical and experimental study of the sequence of events leading up to and following occlusion of the mesenteric vessels.

CARL E. BLACK.

## EXCISION AND REPAIR IN THE TREATMENT OF CANCER

TWO seemingly divorced fields of surgery, during the past few years have received much discussion and intensive study. In the one the surgeon has received the advice and experience of interested and

enthusiastic observers who have approached the treatment of malignancy from many angles other than surgical removal. In the other a comparatively small group of surgeons with careful attention to nomenclature and original thought and trial have refined the details of tissue transference to a point at which anyone following their description may successfully accomplish the most satisfactory of all efforts—construction particularly that which we speak of broadly as plastic surgery.

The discussion of these two fields together may seem strained but it must be apparent that the fundamental effort of one by whatever agent is destruction while the whole purpose of the other by whatever method is construction. If two diametrically opposed surgical principles are merged may not the result of equalization or at least neutralization be expected?

The treatment of cancer is one of the most interesting if not the liveliest problem in surgery today. The uncertainty of cure by any method the multiplicity of forms not only in relative pathological activity but of location and superimposed changes are enough to stir one's interest from purely scientific reasons while the horrible picture of the terminal case can only emphasize the importance of the study if we are to hold to the humanitarian aspects of our profession.

The introduction of new and valued agents of destruction into the treatment has now increased the modes of attack to a point where we must decide upon the merits of surgery select this or that agent alone or in combination. Combination brings up the added question of sequence.

A mere rehearsal is sufficient to explain the ever increasing uncertainty. Keen excision with or without dissection of nodes cauterization with or without dissection cauter





tions to destruction in position will always remain, while the fearsome objection to excision has been largely erased by the wonderfully successful procedures of tissue transfer. And those of us who believe that the hope of a cure is a local growth widely removed can approach and offer our patients plans not only for a cure but for reconstruction.

The more frequent use of the full thickness graft in the Wolfe-Krause form is a great forward step. With attention to details and selection this graft revascularizes and leaves a hardly appreciable scar and it is of great use in exposed areas. The small deep graft of Davis does not yield such good cosmetic results and is not to be considered for exposed places. It has its greatest field in hastening the healing of granulating surfaces following cautery excision.

The Ollier-Thiersch form is by no means to be discarded but its limitations are more to be recognized principally in its greater tendency to contraction and color loss. It is well known that this graft will take on the function of mucous membrane and again with attention to detail will take in the mouth in spite of the unfavorable field. There is also much keener understanding of the differences between grafts and flaps and a fuller appreciation that these are two distinct principles

entirely separate in their application. The use of the flaps—the sliding the jump the tubular the delayed the possibility of transferring grafts as a part of the flap to make two sided epithelial coverings for the cure of defects of nose and cheeks. New's delayed flap on the palate not only of inestimable value in congenital cleft palate but for closure of all defects of the palate or alveolar process the splendid work in reconstructive dentistry the study of compounds for prosthetic models—these procedures and their accomplishment all indicate that we must inject into the treatment of cancer not only the effort at cure but also that of repair.

This is surely no new thought but one waiting development with the anticipation that cases will group themselves along lines of pathology and selective reconstructive step. Groups in which is indicated keen excision and immediate repair others in which cautery excision may be used followed by delayed either early or remote repair. The wisdom of excising all areas apparently cured by other means must also be considered.

While there are many paths from out the Wilderness of Cancer Treatment that which appears broadest and most direct is a local growth widely removed either primarily or secondarily and the substitution of tissue of known value.

HARRY P. RITCHIE



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HARRY P. RITCHIE

# MASTER SURGEONS OF AMERICA

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## CRAWFORD WILLIAMSON LONG

CRAWFORD WILLIAMSON LONG, the discoverer of surgical anæsthesia was the scion of distinguished ancestors. His progenitors immigrated from the north of Ireland to Pennsylvania and Virginia. One grandfather Captain Samuel Long fought through the Revolutionary War under Washington. Edward Ware his maternal grandfather, was a sergeant under LaFayette. After the war the Longs of Pennsylvania and the Wares of Virginia moved to Madison County Georgia where both Revolutionary heroes are buried, their graves being marked by the United States Government in commemoration of their patriotic services. James the son of Captain Samuel Long became one of the most prominent and influential men in Georgia. He married Elizabeth Ware and from this union sprang Crawford Williamson Long.

Crawford Long entered Franklin College now the University of Georgia, at the age of fourteen years taking the degree of A M at nineteen standing second in his class. His roommate and best friend was Alexander H Stephens who became vice president of the Confederacy. Young Long took one year of medicine in Transylvania University. From there he went to the University of Pennsylvania graduating in two years class of 1839.

To have graduated at the University founded by Benjamin Franklin is no mean distinction. The biography of the famous men who have taught or graduated there including Benjamin Rush almost makes the history of American medicine and surgery. During Long's attendance the Faculty included Philip Syng Physic the first surgeon to use buried sutures. William Gibson who tied the common iliac and did two cesarean sections on the same woman. Nathaniel Chapman George B Wood, Hoover Hodge Hare et al. These were the men who taught young Long. Wood never failed to admonish his students to be cautious in announcing new discoveries. Jenner waited twenty years before publishing his discovery of vaccination. Wood's teachings evidently left their impress upon Crawford Long.

Following graduation Dr Long spent eighteen months in New York City 'walking the hospitals'. He gave special attention to surgery and attained an enviable reputation in his work. Returning to his native state Dr Long located at Jefferson a country village. Possessing a pleasing personality, and coming



CRAWFORD W LONG  
1815-1878

quite popular in that part of the state. As the result of his observations of persons under the influence of ether he concluded that an operation might be performed while a patient was under its influence and without pain. But let us have the story in Long's own words. "On numerous occasions I have inhaled ether for its exhilarating properties and would frequently, at some short time subsequent to its inhalation, discover bruises or painful spots on my person which I had received while under the influence of ether. I noticed my friends, while etherized received falls and bangs which I believed were sufficient to produce pain on a person not in a state of anæsthesia and on questioning them they uniformly assured me that they did not feel the least pain from these accidents. These facts are mentioned that the reasons may be apparent why I was induced to make an experiment in etherization.

"The first patient to whom I administered ether in a surgical operation, was Mr James M Venable who then resided within two miles of Jefferson, and at present (1849) lives in Cobb County Georgia. Mr Venable consulted me on several occasions in regard to the propriety of removing two small tumors situated on the back of his neck but would postpone from time to time, having the operations performed from dread of pain. At length I mentioned to him the fact of my receiving bruises while under the influence of the vapour of ether, without suffering, and as I knew him to be fond of and accustomed to inhale ether I suggested to him the probability that the operations might be performed without pain and proposed operating on him while under its influence. He consented to have one tumor removed and the operation was performed the same evening. The ether was given to Mr Venable on a towel and when fully under its influence, I extirpated the tumor. It was encysted and about one half inch in diameter. The patient continued to inhale ether during the time of operation and when informed it was over seemed incredulous until the tumor was shown him. He gave no evidence of suffering during the operation and assured me after it was over that he did not experience the slightest degree of pain from its performance. This operation was performed on March 30 1842.

Dr Long continued the use of sulphuric ether as a surgical anæsthetic, his operations being of record. He published his epoch making discovery by word of mouth to all with whom he came in contact by doing operations in the presence of reliable witnesses and by urging other physicians to use ether as a surgical anæsthetic until it was said that his method became 'notorious' throughout that part of the country among both the profession and laity. Later (1849) in a paper read before the Georgia State Medical Society and published in the *Southern Medical and Surgical Journal* he gave a full account of his discovery.

Documentary evidences of the above statements are published in *Old Penn* vol xiv No 1 October 2 1915, and elsewhere. They are so convincing that they cannot be gainsaid. Practically everyone both in America and Europe, who has

from the greatest university of his day he soon acquired a large practice and became a social favorite as well

Dr Long married Miss Caroline Swain daughter of the president of the University of North Carolina. Fourteen children were born to them two of whom Miss Emma Long and Mrs Frances Long Taylor, are still living in Athens, Georgia where the family moved in 1851. They are the custodians of an enormous amount of literature that has gathered around the history of their father's great discovery

The inhalation of nitrous oxide to produce mental exhilaration or a species of intoxication was known and practiced during the early part of the nineteenth century both in Europe and America. The introduction of this custom was due originally to certain chemists and later its use was broadcast by itinerant lecturers. It was noticed that when the inhalation of nitrous oxide was pushed far enough stupefaction ensued and the subject became unconscious. Wells (1844) got his inspiration from this source and the next day had one of his sound molars extracted while he was under the influence of the gas. Mr. Davy afterward Sir Humphrey called attention to the effects of nitrous oxide as early as 1800 and suggested that probably it might be used to prevent the pain of a surgical operation. In the same year William Allen demonstrated the phenomena of nitrous oxide inhalation to Sir Astley Cooper, at Guy's Hospital noting especially the loss of sensation to pain. While that famous surgeon had eyes to see and ear to hear his spiritual vision failed to discern the wonderful secret that was revealed before him, and for which the profession had sought since the beginning of time. And the world shuddered on under the agony of the surgeon's knife.

It was also observed that sulphuric ether which had set upon the Apothecaries shelves for three hundred years would produce exhilaration and stupefaction as did nitrous oxide. Faraday said in 1818 'When the vapor of ether mixed with common air is inhaled it produces effects similar to those of nitrous oxide gas. Ether by inhalation to relieve the spasm of asthma and phthisis was used by Pearson, of England as early as 1795. Numerous American physicians employed ether for the same purpose. However it was the social use of both ether and nitrous oxide to produce a pleasurable exhilaration for which they were chiefly used. Prof Thompson of Edinburgh frequently entertained his students by exhibition of the exhilarating effects of both sulphuric ether and nitrous oxide. But no one coupled up the anæsthetic effects of ether with a surgical operation.

While Crawford Long was attending lectures in Philadelphia the inhalation of ether to produce mental excitement according to Mitchell was common practice among the lads in that city. It is of record that Long indulged in the favorite pastime himself. The same custom prevailed in New York.

Shortly after Dr Long located in Jefferson he introduced the use of ether by inhalation for its exhilarating effect. Dr Long's "ether frolics" soon became

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 18 19 5 WITH THE PRESIDENT DR DAVID S HILLIS IN THE CHAIR

### REPORT OF CASE OF SARCOMA OF UTERUS

DR W C DANFORTH The patient was a woman of 63 years who had ceased menstruating about 12 years previously. She developed a tumor in the pelvis which was diagnosed by her physician as a fibroid. I later found a circumscribed tumor of the uterus which was freely movable. Material obtained by curettage showed a spindle cell sarcoma. Complete hysterectomy was done. The tumor was confined to the uterus except in one of the large veins of the right broad ligament into which there was an extension of the sarcoma. On the posterior wall there was a breaking through of the capsule. There was apparently no secondary growth. The woman made a good recovery and went home but soon developed a metastatic arthritis. She died about 4 months after the operation from cerebral hemorrhage. Up to the time I saw her last about a month before her death no secondary growth had developed.

Sarcoma of the uterus is rather rare. This is only the second one we have had in the hospital. The other one was not my case.

### SURGICAL MANAGEMENT OF THE ACUTE ABDOMEN

DR W M THOMPSON read a paper on the Surgical Management of the Acute Abdomen. (See p 368)

### DISCUSSION

DR C W BARRETT In regard to peritoneal infections clinically we always think of the reactions against infection as a disease. We are mostly teachers here and in the light of our present knowledge of pathology our literature a few years hence is going to look rather peculiar when it refers to a patient dying from peritonitis, a salpingitis extending to a peritonitis, a local peritonitis extending to a general peritonitis, etc. In a case of peritonitis a patient is sick of the peritoneal infection and if the patient dies it is in spite of the peritonitis, not because of it. Peritonitis is a protective process as are all the other things as well. It is perfectly possible for it to be protective in nature and yet in the end result in deleterious action. This explains the adhesions patients get with peritonitis intended to save the

patient adhesions may be produced that cause obstruction of the bowel and help to destroy the patient. We always should keep in mind that reaction after infection is for and not against the patient.

DR WILLIAM MCL THOMPSON (closing) This subject has interested me particularly along the lines Dr Barrett mentioned. One point is quite important. We are learning a great deal about acute abdominal diseases and as we do we are going to handle such cases much better. Two cases of rupture of the gall bladder and one of rupture of the common duct have been very instructive in the line of conservative handling and careful surgery not too radical. As we learn the real pathology behind these cases and realize the part the peritoneum plays in protection we are better able to reduce our mortality.

### NON SPECIFIC ANTIGENIC EFFECTS OF SPERMATOZOA UPON FERTILITY

DR S J FOGELSON (by invitation) read a paper on Non Specific Antigenic Effects of Spermatozoa upon Fertility. (See p 374)

### DISCUSSION

DR SYDNEY SCHUCHET I would like to ask Dr Fogelson if he uses the same male guinea pigs with the same litter in females? If not it will be difficult to discuss the paper. It is very difficult to express true enzymic action unless you carry out the experiments on a purely mathematical basis. Another fact difficult to understand and one of the most important in the study of enzymes is a static and dynamic element. The study of the static element is conducted in living tissues and of the dynamic in dead tissues. We all know for instance the action of pepsin on any protein and yet there is a difference in the action of pepsin obtained from the same animal. While you get a breaking down of the protein there is a difference in the relationship of the digestive action. From the standpoint of formal attack on digestion there is some effort taken in the stomach by digestion. This study has been carried out by Robertson.

In this other work we must recognize the static and dynamic factors and the question of sensitization of the spermatozoa in relation to follicular



investigated this subject admits that Crawford Williamson Long was the first to employ sulphuric ether as a surgical anæsthetic. Many papers, pamphlets and a few books have been written setting forth in great detail the history of Long's discovery. Numerous monuments have been erected to his memory. Many scientific bodies have declared their belief in Long's priority. His Alma Mater in 1910 unveiled a medallion with imposing ceremonies to commemorate Long's discovery.

In 1902 Congress enacted a law authorizing each State to place a statue of two of its most distinguished citizens in Statuary Hall which is located in the Capitol directly under the dome. The State of Georgia, through its Legislature selected Crawford W. Long and Alexander H. Stephens as its most illustrious representatives. In March of this year the Memorial Association of the Discoverer of Surgical Anæsthesia will unveil in Statuary Hall a statue of Crawford W. Long made of Georgia marble by the famous sculptor J. Masse, Phild. New York City.

That Wells in 1844 used nitrous oxide as an anæsthetic and Morton in 1846 employed ether disguised with aromatics and under the patented name of 'letheon' does not in any way invalidate the fact of Long's priority claim as the discoverer of surgical anæsthesia in 1844.

In the ringing words of Henry W. Grady: 'It was Crawford W. Long who gave to the world the priceless boon of anæsthesia. When Edward VII was operated on for appendicitis his first question on awakening was 'Who discovered anæsthesia?' His surgeon Sir Frederic Treves answered 'It was an American Your Majesty Crawford W. Long.'

JOHN WESSLEY LONG



enzymes I have found similar results except with this degeneration you get a marked degeneration of the brain when you use spermic injection

I would like to know if Dr Fogelson found similar changes in the brain This work suggests a new theory in dementia praecox which sets out to show that there occurs a destruction or auto destruction of spermatozoa in the individual with degeneration of the brain tissue The agglutinins are probably the most important and if one could work that out it would throw most light on the question of sterility

While this paper is extremely interesting and is going to open a new line unless you carry it through you are going to be led into blind alleys in other words you have to use the same animals in the beginning as in the end of your experiments

Dr MARK GOLDSTEIN I think this paper reasonably eliminates any idiopathic sterility when both sides are apparently normal and also the theory that the vaginal secretion can clump the spermatozoa and so prevent pregnancy Of the 17 cases that Dr Fogelson spoke of 7 are pregnant One of them has one child delivered November 23 1915 We will probably have to eliminate the clumping of the spermatozoa by the vaginal secretion as a factor in causing sterility and look carefully for gynecological troubles Often these troubles are of minor character and when corrected pregnancy follows

Dr N S HEAVES Will Dr Fogelson tell us the technique he used in the 17 human cases to deter-

mine whether there was clumping of the sperm with the secretions of the female

Dr S J FOGELSON (closing) In answer to Dr Schochet to use the same animal would be impossible The animal was destroyed and the spermatozoa were taken out and placed in isolated salt solution

Dr Schochet's point is very well taken but there is another factor he apparently overlooked To wit it has been demonstrated that in rodents at least normally there is invasion of the genital mucosa by spermatozoa This recently has been reported by numerous workers in California If that occurs normally we can eliminate this static and dynamic factor which is present in sterility

In regard to autopsy on the rat I did very little microscopic work on sections of the brain and there were no changes I am not in a position to state whether that is a factor even though it occurs If invasion of the mucosa does occur we can cease to worry about static and dynamic effects because this is a normal state of affairs

In regard to the clumping found in the cervical secretion we were very careful in all these patients at the time we were doing the Rubin air test to obtain smears from the cervical secretion We determined the hydrogen ion content here with variations from 10 to 5 With that as a basis we took the cell or extracts of our smears and tested them out in hanging drops with spermatozoa

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

BY ALFRED BROWN, M.D. F.A.C.S. OMAHA, NEBRASKA

### CONSTANTINUS AFRICANUS

THE Arabian school held the foremost position in the medical world beginning with the eighth century. Continental Europe however though to a great extent quiescent had nevertheless not neglected either medical practice or teaching. There the direction of medical matters had passed over gradually from the lay physicians to the clergy. The monks assumed control of the teaching and carried it on in several institutions though at first more in a practical than a theoretical way. One of the first of these schools was the monastery of Monte Cassino. This had been founded by St. Benedict himself on the site of an old temple of Apollo to be used as a place where the sick could come for treatment and where St. Benedict might have the opportunity to work his remarkable cures. These cures were collected by one of the later abbots Desiderius (born 1027) and left by him as Four Books on the Miraculous Cures of St. Benedict. The quality of these cures might be questioned as the following incident shows. Henry II, the Emperor of Bavaria was believed to be afflicted with the stone and came to Monte Cassino for a cure. Henry was a prominent monarch and St. Benedict apparently not wishing to cause him any undue inconvenience himself exerted his special power and removed the stone by libation while he was asleep and then healed the wound at once. That this was done was proven by the fact that when the Emperor awoke the stone was in his hand. What more could be desired.

St. Benedict apparently wished this great power which he had to be his and his alone so as the founder of the monastery he forbade the teaching of medicine there. This prohibition was soon broken and its abbot Berthamus taught medicine both orally and by writing and Monte Cassino held its position as one of the great if not the greatest school in Italy until its reputation was eclipsed by the school of Salerno. During the ninth and tenth centuries this monastery held its position principally through the reputation gained through its association with the miracles of St. Benedict but as time went on something more was needed. Arabian medicine had gradually been improving. As yet its teachings had not crossed the Mediterranean into Europe but it was only a question of time when they would do so. The only unsettled point was the means by which this would be accomplished. The agency turned out to be a Carthaginian by name

Constantinus Africanus who was born some time during the first quarter of the eleventh century. After receiving his preliminary education where it is not known he is supposed to have travelled many years throughout the east including Egypt and India to satisfy his thirst for medical knowledge. Finally he returned home. Whether he entered into practice or not is not established but shortly after his return he was accused of being a sorcerer and finally his life was threatened. One can imagine the feelings of this man who had spent years in the pursuit of knowledge possibly one of the most learned men in Carthage desirous of communicating the results of his labors to others met with accusations of this character which as human nature has not changed much were probably started by competitors mediocre or less than mediocre who were jealous of his attainments. One can see him sick at heart disgusted with the world in general in fear of his very life leaving his native land and fleeing to Italy. There he went to Salerno and joined the famous school teaching for a time. Still being in the world of men and apparently not satisfied he went from Salerno to Monte Cassino where he joined the order became a monk and sought peace and respite from worldly cares and disappointments in the monastery where he could study and write his books which served to bring the medicine and surgery of the orient to the western world.

From this sketch of what is known of his life one would not expect to find much that was original in his work. There may have been some work which he originated but as he does not give the sources from which he obtained his knowledge and makes no differentiation between his own work and that of others it is not possible for us to tell the difference. The work was published from his manuscripts some centuries later. It was translated by him from the oriental languages into Latin which Baas calls barbarous. The work which I have had the privilege of examining consists of three parts. An Anatomy, a Discourse on Elephantia and Medicaments Obtained from Animals. It was published at Basle by Henricus Petrus in August 1541 with works by other writers. Constantinus Africanus deserves recognition as the introducer of Arabian and Oriental medicine into Italy and as the means of initiating the subsequent supremacy of occidental surgery.

Reviewed through the courtesy of the J. H. Crerar Library Chicago

# CONSTANTINI

AFRICANI MEDICI DE HUMANA  
natura, uel de membris principalibus  
corporis humani, Liber I.

375

## De cerebra



Erebrum natura frigidum & humidum est, ideo ut & facile ad susceptionem diuersorum conuerteret, & ut moruentibus membris mobilitatem præstaret, & ut calido & sicco spiritui ad caput exhalanti temperiem inferat. Cuius miringa frigida est & sicca & tensa. Infra quam sunt diuisiones tres. Prima dicitur phantastica. Secunda rationalis. Tertia memorialis. Inter phantasticam & rationalem est pannus quidam frigidus & siccus, & depressior eo qui diuidit inter memoriam & rationem, habens in se modicum tenuissimę carnis. Ex memoriali uero procedunt duo canales tenues & humidi, ut medulla spinalis quę penetrauit compaginē totam, & ueniunt usq; ad phantasticam cellam, per quos possit phantasticus spiritus & rationalis commendari memorię, & iterum memorialis duci ad rationem & phantasiam.

## De auribus

**C**uius auri supra ponitur unum os frigidum & siccum, & sine spiritu quę inferius adherent illi tenui panno qui diuidit inter phantasticam & rationem. Quibus sunt singula foramina, in obliquum facta, habentia tenue initium ab ipso panno. Quę intrinsecus habent indumentum tenuissimum frigidum & siccum, per quod ducitur spiritus ab ipso interiore panno præstans auribus uirtutem audiendi. Et esset audibilis qualitas calida & humida, ut qualiscunq; sonus inferatur auri ab humiditate suscipiatur, à calore attrahatur ad cerebrum, ut sciatur qualis sit. Si cietas uero ossium ad hoc est, ut tinnitus in eis per se que obseruetur, secundū exteriorem euentum.

## De oculis

**O**culorum autem tres sunt tunicę interiores frigidę & humidę. Prima est ut aqua coagulata lucidissima in qua uirtus uisibilis est. Secunda est ut tenuę oui album, Tertia ut utrum modicum  
Et habens

appendicitis only to find the suspected organ normal. In many instances a gall bladder or an appendix is removed and yet the symptoms for which the patient sought relief persist. A close study of a large series of such cases not infrequently reveals the fact that some energetic surgeon has performed a gastro enterostomy for relief of symptoms only to find that the symptoms have been aggravated instead of mitigated.

It is pleasing to note that a considerable number of gastro-enterologists and surgeons have observed colon pathology and its attending disturbed physiology, yet so far as the reviewer knows no definite working plan as to diagnosis and treatment has been established. We are all more or less familiar with Lane's ideas both as to the possible causes and results of colonic stasis and his radical form of treatment. The latter has spelled disaster in a large number of cases in America because of the improper choice of cases and the high mortality rate of colectomy in the hands of the average surgeon.

De Martel and Antoine<sup>1</sup> in their little monograph *Pseudo Ippendicitis* attempt to clarify to some extent this perplexing problem. The authors confine their remarks to a study of the right colon omitting the generally accepted pathological lesions such as carcinoma, tuberculosis and the like. Painful syndromes of the right colon are classified as caused by an abnormally mobile caecum, pericercitis of the caeco colon, ptosis of the right colon, pericolic membranes, pericolicitis of the hepatic flexure and union of the right caeco colon in *Cançons de Fusal*. Three clinical types are observed: mild forms, frank forms and severe and long standing forms. Whatever the nature of the anatomical lesion, they all give rise to the same symptoms which allow one general description. The symptoms and the mechanism of production are vividly described, illustrated by anatomical drawings and roentgenograms. The medical and surgical treatment for the individual types is described.

This work marks a distinct advance in medical knowledge and is deserving of close study by the internist and surgeon. J. A. WOLFE

CURRENT medical literature is becoming so voluminous that the medical man cannot keep abreast of the times if he depends upon his own resources to procure from the various journals those articles in which he might be interested. A number of publishing houses are endeavoring to produce at intervals abstracts covering certain fields. This is an advantage to the busy practitioner in spite of the fact that the specific information on any one topic is brief. The profession at large is familiar with the Collected Papers of the Mayo Clinic and the Mayo Foundation.<sup>1</sup> The issue is welcomed

annually because of the enormous amount of current information it offers. The 1924 number has been before the profession for several months. In this volume the policy of last year has been continued. It is a complete record of all papers for the year 1924 from the Mayo Clinic and the Mayo Foundation every paper being published complete, abridged, abstracted or by title depending upon its interest to the general profession.

The unusual opportunities both physical and inspirational offered by the Clinic are evidenced by a prolific and instructive array of articles for the year—761 authors contributing 225 articles truly a marvelous collection of papers of vast interest to all practitioners of medicine. J. A. WOLFER

**T**HORACIC surgery has become one of the well recognized branches of general surgery with a wide scope of usefulness and a large and interesting literature. There has been however but one attempt made to compile the knowledge of this subject in a single text and that is Sauerbruch's masterful two-volume *Chirurgie der Brustorgane* published in 1924. The English speaking student seeking information on some subject or other of thoracic surgery and not reading German has been confronted with two alternatives: either the necessarily sketchy accounts from the chest chapter of a general surgery or the numerous articles and monographs scattered in various medical journals. Up to the present time there has been no English work dedicated to the entire field of thoracic surgery. For this reason Lauenstein's two volume *Thoracic Surgery* comes most opportunely and fills an urgent need.

It is especially fitting that Dr. Lihenthal should have been the author of this first text. Not only has he been one of the pioneers in this field but he has done as much as any one else to develop this specialty to its present stage of importance. For years he has been the authority on lung abscess, lobectomy etc. and whatever he has said and written has been considered as being *ex cathedra*.

The completed work has been no disappointment much as has been expected of it impatiently as it has been awaited. In two volumes written in clear and concise form well illustrated well arranged well indexed, the entire subject of thoracic surgery has been covered. As much detail as is necessary for a complete understanding of the subject has been inserted. Useless discussion has been avoided and procedures once advocated but later found impracticable have been entirely omitted or just mentioned as of historical interest.

The work is to be especially recommended to the general practitioner or the internist who for the most part have not begun to comprehend how much surgery has to offer in the treatment of diseases of the lungs and mediastinum. To the surgeon

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D. Phil. <sup>Th. & Soc. Sci.</sup> By H. W. d. L. L. <sup>The S. & I. AL T. EA MENT</sup> F. Th. <sup>ACTO</sup>  
 Phil. <sup>help</sup> d. Lo. d. <sup>th. B. ba. dera Comma v. to s.</sup>



# SURGERY, GYNECOLOGY AND OBSTETRICS

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## CONGENITAL DISLOCATION OF THE HIP<sup>1</sup>

By VITTORIO PUTTI M.D. BOLOGNA ITALY

A FEW months ago when I had the pleasure of receiving a visit from the Director General of the American College of Surgeons and I submitted to him a choice of subjects that I might present at the Clinical Congress he advised me to speak upon congenital dislocation of the hip. He selected a subject of great practical importance indeed but perhaps not the one most suited to rouse the interest of the general surgeon.

I accepted with pleasure however the advice of Dr. Franklin Martin because it gave me an opportunity to speak on a subject on which I feel competent to speak.

From the standpoint of my own experience I want briefly to lay before you the facts which I consider all important in dealing with congenital dislocation of the hip namely (1) its etiology and pathogenesis (2) its diagnosis and (3) its treatment.

### ETIOLOGY

Concerning the etiology it is interesting to note that dislocation may be of hereditary and familial origin. From our statistics which up to the year 1924 record 1,879 cases with a total of 2,556 dislocations heredity plays a part in an average of 13 per cent. It is familial in an average of 10 per cent. The deformity is far more common in females. Our statistics reveal that 84.9 per cent of the cases were girls, 15.1 per cent boys, which would give us an average of eight girls to one boy. In 60

per cent of the cases the dislocations were single, in 39 per cent the deformity was bilateral.

It is curious to note the geographical distribution of the disease. In Italy for example we find the deformity frequent in the northern provinces, rare in the south and almost unknown in Sicily. I am not in possession of precise information regarding the United States but I am under the impression that the dislocation is far less common in North and South America than it is in Europe. It is certain that in the United States dislocation is more common among the white than among the colored people.

From our statistics it seems apparent that the hereditary factor cannot be overlooked. Notwithstanding the fact that the latest and most creditable theories of pathogenesis are inclined to point to the mechanical origin of the deformity, we are forced to admit that this theory does not fully explain every case of dislocation. At the same time the hereditary origin leads us to suppose that in some cases the origin of the deformity must be traced beyond any mechanical cause that it is produced possibly from atypical morphological conditions which can be transmitted from one generation to the other. In the majority of cases however the mechanical origin is as yet the most plausible explanation and the one which appears to throw most light on the anatomical as well as on the clinical aspects of the disease.

<sup>1</sup>Presented with moving picture film before Clinical Congress, 3 Ann. at a College of Surgeons, Philadelphia, Oct. 26, 1925.





was practiced before Paci taught us the method of reduction through manipulation. But open intervention has not been altogether abandoned. Some surgeons still resort to it frequently. Our experience would lead us to be very conservative in using this method. It should be used only in those cases in which the reduction cannot be obtained by the ordinary method. And we cannot deny that this is quite often the case. When the reduction is attempted in patients of an advanced age and also in young patients in whom the primary displacements are very marked and there is a misshapen capsule or serious anteversion of the femoral neck, failure may follow the Paci treatment. Then and then only must the surgeon play his last card by attempting the open operation. We gather that this occurs on an average in 5 per cent of the cases.

The technique which I use in the open operation is as follows. A straight incision is made beginning about 2 inches above the anterosuperior spine of the ilium and carried along the crest down to and beyond the anterior superior spine. The muscles rectus femoris and tensor fascia femoris are separated and well retracted by blunt dissection. The capsule is exposed. An incision is made through the capsule. Special retractors are used to expose the head of the femur to full view. The capsule is examined for constrictions. The capsule is usually shaped like a funnel and this occasionally prevents reduction. A special instrument in the form of a dilator is inserted through this narrow constricting portion of the capsule and the capsule forcibly dilated. A special instrument in the form of a skid similar to that of a Murphy skid is introduced into the dilated portion of the capsule and into the normal acetabular cavity. The knee is grasped and the femoral head abducted and inverted over the sliding instrument into the acetabular cavity. The wound is closed in the usual manner without drainage. Dressings are applied and the thigh is placed in right angle abduction and slight internal rotation similar to that used in the closed method.

I have so far discussed the treatment of dislocation in patients who are within the age limit

which experience has taught us to be the best for obtaining favorable results that is, for bilateral dislocation a maximum age of 4 years and for single dislocations a maximum of 7 years.

What shall the surgeon do when he is confronted with a case in which the age limit is passed? It is hardly possible to give a definite answer to this question. There are cases in which the patient's age excludes the possibility of obtaining a perfect functional and anatomic recovery but in which intervention cannot be avoided. In other cases the surgeon must advise against intervention. The surgeon must judge not on the actual state of the dislocation but must be lead in advising to consider the future of the patient and the complications which may eventually arise from the existing deformity. There is a danger which usually becomes manifest only after the fifteenth or the twentieth year that is traumatic arthritis which is the cause of pain, rigidity, stiffness and consequently functional impediment. If these symptoms appear early that is before the fifteenth year of age, they are sufficient cause for operation. Even if ankylosis results this is sometimes preferable to a painful dislocation.

Once intervention has been decided on, one has the choice between the bloodless method, the open reduction and the other palliative operations such as the anterior transposition, subtrochanteric osteotomy or the bifurcation of Lorenz. In suitable cases we have succeeded in obtaining reductions by manipulation even in patients of 20 and 21 years of age. Open intervention must always be considered as a serious operation to be resorted to only in certain well defined cases.

In four cases I performed a real arthroplasty of the hip modeling in a suitable manner the femoral epiphysis deepening with an electric drill the cotyloid cavity and interposing a flap of fascia lata.

Among the palliative methods which can be suitably employed we have the anterior transposition and the so called bifurcation operation of Lorenz, that is an intervention destined to place a stump of the diaphysis instead of the femoral head into the acetabular cavity.

This point of view further seems to conform with the somewhat anthropological theory of Le Demany according to whom the pathogenesis of dislocation is simply the static and mechanical result of a misplacement from an anthropological transformation of the pelvis. According to the theory of mechanical pathogenesis we must consider congenital dislocation of the hip as the result of chronic trauma to which the lower limbs and consequently the hip joints of the fetus are exposed in the second half of prenatal life. The flexion and external rotation of the lower limbs of the fetus, the lack of proportion which physiologically exists between the femoral head and the socket, the softness of the border of the socket, the physiological anteversion of the neck of the femur are all favorable conditions for an incipient dislocation which would manifest itself only after birth when the limbs of the fetus pass from flexion to extension and would appear more evident later when the joint has to carry the weight of the body. Personally we favor the theory of mechanical pathogenesis but we do not believe that this theory explains every specific case. Dislocation can be the result of a number of factors of which the mechanical one is without any doubt the most frequent if not the only cause.

#### DIAGNOSIS

The second question which I wish to discuss concerns the diagnosis of the dislocation. It may seem strange to you that I place special stress on this argument because every one of you may be convinced that there is nothing new to be said about the diagnosis of congenital dislocation. Indeed this may be true when one is about to diagnose the deformity in a child who has already begun to walk.

The typical waddling gait is a sufficient symptom to make one suspect a dislocation and this suspicion is easily confirmed by the X-ray. But I wish to emphasize that it is of the greatest importance to recognize the dislocation as early as possible even before the child has begun to walk. Therefore it is necessary to appreciate symptoms that are not generally known or to which no importance is given. These symptoms can be summarized as follows. If the dislocation is unilateral the

cutaneous creases of the thigh, so evident in the infant are no longer symmetrical. On the dislocated side they are proximally displaced, the inguinal and gluteal pleats are deeper and longer than on the normal side. The outline of the dislocated hip is more prominent. The luxated limb has a tendency toward external rotation. Abduction is slightly diminished. Shortening is nearly always minimal but appreciable to the skilled eye. If the dislocation is bilateral there is no difference in length in the limbs but the pelvis appears enlarged because of the projection of the trochanters, the buttocks are flattened and the limb can not be normally abducted.

In those countries where congenital dislocation is frequent as for example in the northern part of Italy it happens frequently that the deformity is suspected by the mother even before the child learns how to walk. This is partially due to the propaganda which is intensively carried on to educate parents to bring their infants who show any tendency to dislocation at the earliest possible moment and place them under the observation and care of a specialist.

I am absolutely convinced that the practice of operating on the dislocation early will bring a decisive improvement in the results.

#### TREATMENT

Ordinarily in the treatment of dislocation I follow the classical method of Paci whose technique I need not describe. For the immobilization I follow in a general way the methods of Lorenz. Differing from what is commonly done in America I divide the immobilization periods in two stages. In the first stage the limb is held in the classical first position of Lorenz for approximately 3 months. During the second stage that lasts from 2 to 3 months the limb is immobilized in a minor degree of right angle abduction and in internal rotation. Great importance should be given to the physical treatment which must be undertaken when the period of immobilization ceases.

All that we have said refers to the bloodless method of treating dislocation, a method which we may say has entirely replaced the open operation which as you remember

## SECONDARY OPERATIONS ON THE COMMON BILE DUCT

BY WALTERMAN WALTERS M.D. ROCHESTER MINNESOTA  
D. S. Surgery M. y. Clin.

**D**URING the last few years noteworthy advances have been made in the treatment of complicated disturbances of the biliary tract. These have consisted of studies of the blood and clinical methods of examinations that have indexed the patient's condition so that the most opportune time for operation and the extent of safe operative procedures can be accurately determined. Rehabilitation of the patient with obstructive jaundice by means of intravenous injections of calcium chloride and glucose solutions before and after operation has been of value in this respect.

The van den Bergh test enables one to determine the quantity of bile pigment circulating in the blood serum from day to day, the surgical significance of which is in the opportunity thus afforded of delaying operative measures when the bile retention is increasing because of the risk of postoperative bleeding or hepatic dysfunction.

The fact that removal of the dog's liver, as shown by Mann, is accompanied among other changes by such a decrease in the amount of blood sugar that tetanic convulsions ensue and the fact that the convulsions cease immediately after the intravenous injection of glucose solution have led to the use of intravenous injections of the glucose solution in many patients with disturbance of the liver.

In 1909 Abel and Rowntree demonstrated that halogenated phenolphthalein (phenol tetrachlorophthalein) was excreted totally in the bile. Based on this fact Graham using the sodium salt of other halogenated phenolphthaleins (tetrabromophenolphthalein and tetraiodophenolphthalein) has shown that the bile in the gall bladder becomes opaque to the roentgen ray after their oral and intravenous administration. The use of this method of cholecystography and the proper interpretation of findings have greatly increased the accuracy of the roentgenographic diagnosis of gall bladder dysfunction. The practical application of these principles has

made it possible to extend operability to include many patients with complicated disease of the biliary tract who in earlier years would have been denied operation because of the grave risk entailed.

## SECONDARY OPERATIONS ON THE COMMON BILE DUCT

From the standpoint of diagnosis and treatment of disease of the biliary tract in involvement of the common bile duct often causes unsuspected postoperative complications. In some instances therefore a satisfactory operation may be performed on the gall bladder and the disease of the common bile duct may be overlooked either as a result of failure to recognize the cardinal signs and symptoms of disease of the duct or of failure to explore it properly. Yet the technique employed in operating on the common and hepatic bile ducts is not difficult, after the common duct has been identified. Such cases of common duct disease are not infrequently overlooked at operation. For instance during the last 6 months I have performed secondary operations for disease of the common bile duct in 6 cases in which symptoms prior to the first operation were characteristic of involvement of the common bile duct. A summary of these is appended. Although careful attention had been given at the previous operations to the treatment of the diseased gall bladder the existence of a stone in the common duct had not been discovered. In Cases 1 and 2 the stones were large enough to be felt on palpation of the duct and accessible enough to be removed by simply cutting down on them (Fig. 1).

Included with the present series of cases in which secondary operations on the biliary tract were necessary are short abstracts of 7 other cases of common duct involvement in which I operated during the same period. Each case is illustrative of a different group in which obstructive jaundice is a complicating factor of biliary tract disease.

## RESULTS

And now before closing let me say a few words as to the results

The improvement in technique which is the result of increased experience and the belief that we must treat dislocations at the earliest possible age are the principal factors in our improved statistical data. Our statistics for the year 1913 which include only 700 cases show an average of functional and anatomical success around 80 per cent for single dislocations and 60 per cent for bilateral. On the basis of 1 879 cases with 2 556 reductions we may say that we have succeeded in 90 per cent of the single dislocations and we have improved 65 per cent of the bilateral cases. By this I do not mean to say that the remaining cases are entire failures. Anterior transposition may sometimes (particularly in bilateral dislocations) produce results which are functionally just as satisfactory as those which are anatomically perfect. We must not forget that modern technique has taught

us how to avoid the greater number of those incidents which are apt to produce the greatest damage in unsuccessful treatment such as fracture of the femoral neck and the paralysis of periarticular nerves.

We are further convinced that the treatment of dislocation of the hip will in the future show results which will increase our present figures as regards successful cases. This will be easily accomplished when it becomes generally possible to begin the treatment at an earlier age than is now the case.

I have endeavored to outline the principal facts which should be known regarding deformity, a study of which is one of the most interesting chapters in the history of orthopedic surgery. I do not presume to have been able to give you a clear vision of this vast problem but even had I spoken at greater length I would probably not have succeeded in making the facts clearer. In discussing these subjects words are of little value if not accompanied by practical demonstrations.

relieved. But if the jaundice is decreasing the patient withstands the operation almost as well as though it had not existed.

#### PAINLESS JAUNDICE

In a few cases (more often in men than in women) painless jaundice may exist as a result of a single stone in the common duct although it is usually the result of pancreatic obstruction, due either to malignant or inflammatory changes compressing the pancreatic portion of the common bile duct or to carcinoma of the duct itself (Case 10). Should the jaundice be the result of a common duct stone a period of observation prior to operation may allow the jaundice to decrease and also permit the development of additional symptoms to clarify the diagnosis. This principle is well illustrated in Case 7 in which there was probably an obstructing stone in the common bile duct with no symptoms other than the jaundice. While the patient was under observation he developed his first attack of gall stone colic and undoubtedly passed the common duct stone for subsequently the jaundice began to diminish. A gangrenous gall bladder impacted gall stone in the cystic duct and a dilated thickened common bile duct were found at operation (Fig 7). In Case 13 pain

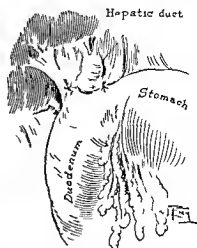


Fig 4 (Case 5) Hepaticoduodenostomy over a tube

less jaundice had existed for months before an attack of gall stone colic occurred and at operation a mass of soft putty like stony material impacted in the ampulla and a gall bladder filled with stones were removed. Stones formed in the common duct, after the gall bladder has been removed are usually soft granular or putty like, and contain little or no cholesterol.

#### PAIN RESULTING FROM OBSTRUCTION OF THE BILIARY TRACT

The persistence of gall stone colic, after the removal of the gall bladder is suggestive of stones in the common or hepatic ducts. In Case 12 cholecystectomy was performed for empyema of the gall bladder in September 1919. At that time the common duct was opened and explored because of jaundice but no obstruction or stone was encountered. An enlarged spleen was noted. In August 1925 the gall stone colics returned with an increase in the jaundice. A mass of putty like material approximately 1.5 centimeters in diameter was removed from the lower end of the common duct and splenectomy performed at the same time for the complicating hemolytic jaundice. The patient made a good recovery and the jaundice disappeared.

In some instances a postoperative incomplete stricture of the common bile duct will cause attacks of upper abdominal colic simulating that which results from an obstructing

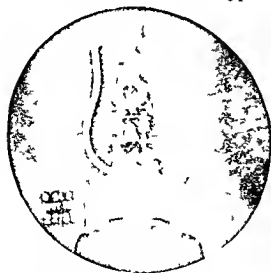


Fig 3 (Case 4) Roentgenogram 3 weeks after operation showing catheter in place

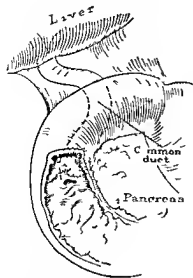


Fig 1 (Case 1) Stone 3 by 2 centimeters in the common duct just above the papilla

#### THE ABSENCE OF JAUNDICE

In 30 per cent of the chronic cases in which a stone is present in the common bile duct there may be no jaundice at the time of operation because of the fact that a movable stone in the common duct may not produce jaundice until it becomes fixed. Fenger was the first to explain and demonstrate a ball valve stone. The history and operative findings in Case 3 are quite characteristic of such a condition. Again there may be a number of stones in the common bile duct and little or no jaundice until the distal stone becomes impacted in the duct after which there is obstruction and jaundice. Recently I operated on a patient (Case 8) whose only attack of jaundice had followed a gall stone colic 12 years previously. She had had frequent gall stone colics since that time but no jaundice. At operation three stones were removed from the common duct and two from the hepatic ducts. Palpation of the duct revealed their presence. The absence of jaundice in the presence of one or more stones in the common bile duct can sometimes be explained by the resiliency in the wall of the duct probably because there is little secondary infection.

Charcot's syndrome consisting of chills, sensations and fever, is quite indicative of involvement of the common bile duct in a patient who complains of upper abdominal pains either before or during such febrile attacks provided the renal factor has been eliminated (Case 1).

#### THE PRESENCE OF JAUNDICE

Most patients with stones in the common duct have jaundice at one time or another following an attack of abdominal pain of which Case 9 is a typical example. Jaundice resulting from a stone in the common bile duct will usually diminish in intensity with the lapse of time. When the skin has become bile tinged as a result of the biliary obstruction it is often difficult to determine when the obstruction has subsided. The van den Bergh test makes it possible to estimate accurately the amount of bile pigment circulating in the blood serum from day to day.

Operation should be delayed when the bile in the blood serum is increasing. Sometimes this rule is followed with difficulty and yet experience has shown that an operation at such a time is performed with great risk even though the biliary obstruction is successfully

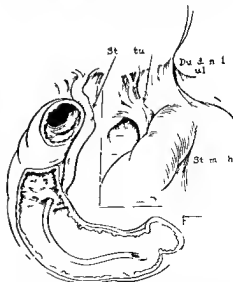


Fig 2 (Case 4) Reconstruction of a common duct with a McArthur catheter

they may sometimes be brought down by inserting the little finger into the proximal end of the bile duct through the exploratory opening, the finger being used as a piston to suck the stones into view. Courvoisier called attention to the ease of removing a stone in the middle portion of the common bile duct by grasping the duct and stone in the left hand and cutting directly down on the stone, as one would on a darning ball in a stocking. Bartlett's common duct retractor is often useful. Stones in the lower portion of the common duct may be worked by the thumb and forefinger of the left hand into the upper portion of the duct and removed through the incision. If such stones are impacted, a pair of Desjardin forceps introduced into the duct makes it possible in most cases to grasp and remove the stone easily through the exploratory incision in the duct.

Obstruction in the lower end of the common bile duct may be due either to a stone or to abnormal changes in the head of the pancreas. If a probe or scoop cannot be passed through the lower end of the common bile duct into the duodenum, the reason for this failure must be ascertained even if it necessitates making a transduodenal exposure of the ampulla (9, 17). This procedure was used to advantage in the removal of a coincidental duodenal ulcer (Case 4, Figs 2 and 3) and greatly assisted in removing all of the stony material impacted in the ampulla in Case 13. The importance of determining the presence of all obstruction in the biliary tract and removing it if possible cannot be too strongly emphasized; it has been found that in 50 per cent of patients who die following operation for common duct stone a stone has been overlooked in the biliary tract.

Sometimes a small stone at or near the papilla will be pushed ahead of the scoop into the duodenum freeing the duct. The scoop for clearing the duct must be used without too much force as otherwise the stone may slip to one side into a traumatic diverticulum permitting the scoop to slip by the stone into the duodenum and thus lead to the erroneous belief that the duct is free from stones. There is no probe like the finger and when the duct is sufficiently dilated to admit the finger, the

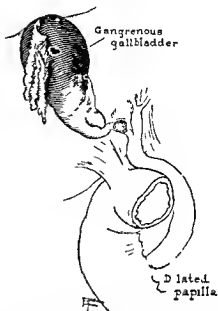


Fig. 7 (Case 7) Stone in cystic duct. Note gangrenous gall bladder enlarged common duct and dilated papilla.

discovery of a stone is facilitated greatly. If the head of the pancreas is enlarged, it may be very difficult to be certain that stones are not overlooked.

#### STRICTURES OF THE COMMON BILE DUCT

Most strictures of the common bile duct are the result of injury to the duct or of infection following previous operations (Case 12). It is true that congenital stricture of the common duct is a possibility although it is extremely rare and also that stricture may occur as a result of typhoidal ulceration syphilis or an extensive duodenal ulcer. If in removing a gall bladder, one is always careful to expose and isolate the cystic duct at its union with the gall bladder there is little if any chance of injuring the common or hepatic ducts. Similarly the same attention to the cystic artery is advisable for the retraction of this artery during an operation on the gall bladder and the hasty attempt to catch it with sharp toothed forceps is often the cause of injury to the biliary ducts.

Not only is the surgical treatment of stricture of the common duct tedious and difficult but the end results in many instances are not satisfactory. In the repair of a stricture of





Fig 5 (Case 5) Roentgenogram 3 weeks after operation showing tube in place



Fig 6 (Case 6) Roentgenogram showing catheter in place

stone (Cases 4 and 6 Figs 2 3 and 6) In a few cases in which operation had been performed dense adhesions formed around the duct, compressing it sufficiently to produce intermittent obstruction

#### THE SIZE OF THE DUCT

The normal common bile duct is approximately 7.5 centimeters in length and from 5 to 7 millimeters in diameter and appears bluish from contained bile. When it is affected either by infection or by obstructing stone its walls become thickened the color changes to yellowish white and the caliber is noticeably increased. These changes are indications for exploration of the duct even in the absence of jaundice or other symptoms of common duct disease.

In secondary operations on the common bile duct the relationship of the common duct the hepatic artery and the portal vein may be distorted as the result of the formation of scar tissue and if there is doubt as to the position of the duct a hypodermic syringe

with the needle as an aspirator is of great assistance in identifying it. Should the portal vein be mistaken for the common bile duct a needle puncture is of no consequence and bleeding can be controlled easily. The aspirating needle must be of sufficient caliber to permit the free entrance into the syringe of bile thickened by disease otherwise as a result of frequent needle punctures through the common duct there may be bleeding into its interior and blood instead of bile will be aspirated with the erroneous conclusion that the portal vein has been punctured.

#### REMOVAL OF STONES FROM THE DUCTS

Stones in the hepatic ducts unless firmly impacted often wash down with the first rush of bile into the common duct when the latter is incised. A delay of a minute or two after the incision is made gives time for such stones to appear. Stones only slightly impacted in the hepatic ducts can usually be removed with a common duct scoop if not

malignant condition at the head of the pancreas Deaver believes that the symptoms of pancreatitis may simulate those most typical of a common duct stone. Helly in a study of the relation of the pancreatic portion of the common bile duct to the pancreas showed that in 25 of 40 cases the duct passed through the substance of the gland, while in the remaining 15 cases it was not entirely surrounded by pancreatic tissue. We may be assured then that if pancreatitis is associated more than 60 per cent of patients will be jaundiced.

Moynihan has called attention to the fact that when jaundice is the result of pancreatic malignancy, rigor and intermittent fever are usually absent. No variation occurs in the jaundice and often there is intense steady pain in the back. In many cases it is very difficult to distinguish between these two conditions, even at operation and for this reason when ever the general condition of the patient permits an anastomosis is made between the gall bladder and the gastro intestinal tract. Such was the condition in Case 10. A history of intermittent fever and jaundice for almost 2 years was sufficient reason after the demonstration of a tumor at the head of the pancreas for cholecystogastrostomy. The patient withstood the operation with little reaction and was dismissed from observation 4 weeks later free from fever and jaundice and gaining in weight. The pancreatic tumor may have been the result of inflammatory pancreatitis or secondary to a slow growing pancreatic carcinoma. The operation will benefit the patient in either event by relieving the obstruction in the biliary tract and adding considerable comfort to his existence. Should the obstruction be the result of pancreatitis the patient will recover and remain well.

#### POSTOPERATIVE TREATMENT

Usually patients convalesce uneventfully when operated on after preliminary preparation consisting of intravenous injections of 5 cubic centimeters of 10 per cent calcium chloride solution adequate fluids and abundant carbohydrates especially glucose. Should the patient fail to convalesce satisfactorily the blood is studied. Should the acid alkali balance be disturbed intravenous injections

of sodium bicarbonate are given to control acidosis or sodium chloride to control alkalosis. These are usually added to a solution of 10 per cent glucose. The stomach tube is used if there is gastric retention which is usually evidenced by hiccups, or persistent vomiting of small amounts. Should bleeding occur following the operation, the intravenous injections of calcium chloride are resumed and a blood transfusion performed if necessary.

#### REPORT OF CASES

**CASE 1** A woman aged 45 had had gall stone colic and was jaundiced in November 1923. In May 1924 cholecystostomy was performed elsewhere but no stones were found in the gall bladder. The biliary fistula closed in 6 weeks but the jaundice did not diminish. The patient continued having pain in the right upper quadrant and also between the shoulder blades. At times she had had chills and fever.

Examination revealed jaundice 3 and serum bilirubin 8.9 milligrams for each 100 cubic centimeters. A diagnosis was made of stone in the common duct. At operation (choledochostomy) a stone 3 by 2 centimeters was found in the common duct just above the papilla and removed. The patient made a good recovery (Fig. 1).

**CASE 2** A woman aged 61 had had cholecystostomy for gall stones appendectomy in September 1923 elsewhere and cholecystectomy for gall stones in July 1924 elsewhere. She continued to have attacks of gall stone colic with jaundice.

Examination revealed jaundice 2 and serum bilirubin 3 milligrams. A diagnosis of stone in the common duct was made and at operation a stone 1 centimeter in diameter was found in the lower end of the common duct and removed. The patient recovered uneventfully.

**CASE 3** A woman aged 59 had had two previous operations elsewhere on the gall bladder: cholecystostomy in 1917 and drainage of an abscess in 1921. Since the fall of 1924 she had had five attacks of pain in the upper right quadrant of the abdomen accompanied by chilliness and cold sweats. Jaundice occasionally followed pain when the stools were light in color.

Examination disclosed tenderness in the epigastrium but no jaundice. The diagnosis was recurring cholecystitis and probable ball valve stone in the common duct. Choledochostomy and cholecystectomy were performed and the ball valve stone was removed from the common duct. The stone was about 8 millimeters in diameter and situated in the ampulla at the lower end of the common duct. Chronic cholecystitis was confirmed at operation but no stones were found in the gall bladder. The patient recovered and has been free from symptoms since.

the common or hepatic ducts the essential factor is the replacement of the affected tissue by tissue immune to the irritating effects of bile so as to prevent secondary strictures from the contraction of fibrous tissue as shown by Horsley

There are two methods of reconstructing the common bile duct for stricture. The first method is direct implantation of the duct or portion of the duct into the duodenum, as performed by W J Mayo in 1905. Because of the union of mucous membrane to mucous membrane this operation is not marred by postoperative contraction of fibrous tissue and has given excellent lasting results. Such a procedure was used in Case 5 the stump of the hepatic duct being anastomosed to the duodenum over a short piece of catheter and cuffed to maintain it in position until union occurred at the anastomosis (Figs. 4 and 5). Walton, in 1913 modified the operation by using a flap of duodenal tissue as a tube and connecting the cut end of the hepatic duct to the duodenum anastomosis being made over a portion of a rubber tube.

The second method indirect implantation depends on the use of a rubber tube or similar structure to fill the gap between the cut ends of the ducts and the intestine. Sullivan who called attention to this method in 1900 suggested using a tube or piece of catheter to bridge the gap between the stump of hepatic duct and the duodenum covering the bridge with omentum and surrounding structures.

Propping advocated the use of a T tube to assist in the reconstruction of the common duct for stricture the upper shorter end of the tube being placed in the hepatic duct the lower end extending through the lower end of the duct into the duodenum with the perpendicular limb of the tube coming out through the abdomen. Although the T tube is still used in the plastic repair of such strictures the results following its removal have not been altogether satisfactory in some cases scar forms at the opening made in the duct for removal of the tube.

In cases of small stricture in the center of the common duct the stricture can be divided and a plastic repair made by using McArthur's method of inserting a catheter its

bell end being cuffed and placed in the hepatic duct and the catheter itself extending through the common duct down into the lumen of the duodenum through the ampulla of Vater (Cases 4 and 6, Figs. 2, 3 and 6). The catheter establishes the continuity of the biliary tract, and at the same time provides the scaffolding for plastic repair of the stricture. The tube can be maintained in place by catgut suture or by means of a silk thread passed through it brought out through the abdominal wound and fastened to the abdomen with adhesive. The silk thread is removed and the tug of intestinal peristalsis carries the tube out of the duct and through the intestines at the required time.

Another method of indirect implantation is the anastomosis of the fistulous biliary tract to the gastro intestinal tract. This operation was first performed by von Stubenrauch and failed. Later Murphy anastomosed the end of a fistulous biliary tract to the exposed lower end of a common bile duct and recently Lahey has reported two successful cases in which the fistulous biliary tract was transplanted into the duodenum.

In a very small group of cases in which operations on the biliary tract have been performed the attacks of pain and a retention type of vomiting similar to that of pyloric spasm persist. Exploration of the common duct in such cases may not reveal gross cause for the obstructive manifestations and yet when one passes an olive tipped probe through the lower portion of the common bile duct there is a distinct tug felt as it enters the ampulla and again as it goes through the sphincter of Oddi into the duodenum (Case 11). The same tugs are again experienced on the withdrawal of the probe so that this might be considered a possible cause of an intermittent obstruction in the common duct in the absence of other obstruction. Mechanical dilatation usually results in a subsidence of the symptoms.

#### PANCREATIC OBSTRUCTION

Obstruction of the pancreatic portion of the common duct may be a result of primary inflammation or it may be secondary to inflammatory conditions in the biliary tract or to a

cause of the intermittent character of the jaundice and fever and the long period of time elapsing since its onset exploration of the biliary tract and pancreas was advised. A mass was found at the head of the pancreas producing distention of the biliary tract. An anastomosis was made between the gall bladder and the stomach (cholecystogastrostomy). The patient withstood the operation satisfactorily and a month later his jaundice had disappeared but he had regained his appetite and was regaining his strength. It was difficult to tell from the consistency and contour of the mass at the head of the pancreas whether it was due to pancreatitis or malignancy.

**CASE II.** A Syrian woman aged 40 had had a history of pain in the area of the gall bladder for 10 years. Cholecystectomy with removal of four stones was performed in August 1924 elsewhere. Four months later the dull steady pain again appeared with attacks of colic sometimes accompanied by jaundice. The pain was under the right costal margin and at times extended around the ribs to the back.

At the time of examination the attacks occurred every 2 or 3 days at times with nausea and vomiting. The van den Bergh test for bilirubin in the blood showed 0.7 milligrams in 100 cubic centimeters. Exploration of the common and hepatic ducts and pancreas was performed December 17 1925. There were slight adhesions and the common duct was enlarged even more than it should be after the removal of the gall bladder. It was difficult to pass a scoop through the common duct at first but finally a large scoop was passed. The adhesions around the duct were separated and a small drain was inserted in the hepatic duct. The patient left the hospital in good condition.

**CASE 12.** A man aged 51 had had a cholecystectomy and an exploratory choledochotomy for subacute empyema of the gall bladder with gall stones in September 1919. He was slightly jaundiced but no obstruction was found in the common bile duct. It was noted that the spleen was twice its normal size and there was some cirrhosis of the liver. The tinge of jaundice continued after the first operation and his general health was only fair. In the first week of August 1925 he had another attack of gall stone colic severe enough to require morphine with a slight increase in the jaundice and with clay colored stools.

On examination there was slight tenderness over the right upper quadrant and 0.5 milligram of serum bilirubin in 100 cubic centimeters of blood. The history of familial jaundice and the presence of a tinge of jaundice practically since birth with secondary anaemia and reduced erythrocytes led us to believe that a haemolytic jaundice was associated with biliary tract disease. At operation a large common duct stone was found and a mass of putty like material was removed from the lower end of the common bile duct. Because of the enlargement in the spleen and the history suggestive of haemolytic

jaundice it was thought advisable to perform splenectomy. The patient recovered satisfactorily from the operation the jaundice disappeared and he was dismissed in excellent condition.

**CASE 13.** A woman aged 52 complained of general weakness with loss of strength followed by painless jaundice. A month later a sharp attack of pain occurred in the right upper quadrant radiating to the epigastrium and around to the back. The pain was severe enough to require morphine. Since then a dull aching had persisted in the right upper quadrant. Occasionally she had had diarrhoea and light colored stools with bloating and gas eructation after meals. She had lost 25 pounds in the last 6 months.

On examination the patient was found to be jaundiced 2 and tender in the right upper quadrant of the abdomen. A diagnosis of common duct obstruction was made with a 50 per cent chance of a malignancy. At operation a distended gall bladder and common duct were found. Impacted in the ampulla was a mass of putty like stony material approximately 1.5 centimeters in diameter. It was so firmly fixed that a trans duodenal exposure at the papilla and an opening in the common duct were necessary in order to remove all the fragments of stone. The gall bladder was filled with stones and thick caramel colored bile. The gall bladder was removed and a catheter placed in the common duct. The opening in the duodenum was sutured. The pancreas was apparently normal and there were no other stones in the hepatic duct. The patient's convalescence was satisfactory until the ninth day when following the removal of a gauze drain a hemorrhage occurred from the drainage tract. This ceased during the next 24 hours. Three days after the first hemorrhage a second occurred which necessitated blood transfusion and packing of the operative area with gauze.

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**CASE 4** A woman aged 34 had had cholecystectomy elsewhere in 1919 without relief from symptoms. During the last 2 years she had had 8 attacks of colic requiring morphine. Pain had been continuous in the upper abdomen for the last 5 months. Four weeks before examination jaundice appeared.

Examination revealed jaundice 3 and bilirubin (van den Bergh test) 9 milligrams July 16 1925 and 2.8 milligrams July 25. Test of hepatic function showed phenoltetrachlorophthalein retention 4. At operation stricture of the middle third of the common duct and duodenal ulcer were discovered. Reconstruction of the strictured duct over a McArthur catheter with excision of the duodenal ulcer and gastroduodenostomy were followed by recovery of the patient (Figs. 2 and 3).

**CASE 5** A woman aged 64 had had cholecystectomy elsewhere for gall stones in December 1923. Two large stones were found in the gall bladder. A biliary fistula and jaundice had existed since the operation. At exploration elsewhere in April 1924 a stricture of the common duct was found but nothing was done.

Examination showed a draining biliary fistula and jaundice 2. A diagnosis was made of obstruction of the common duct and biliary fistula. At operation a stricture throughout the entire length of the common duct to the level of the liver was found and hepaticoduodenostomy was performed. The hepatic duct being sutured to an opening made in the duodenum over a piece of catheter. The patient recovered (Figs. 4 and 5) and the jaundice subsided. She has recently had a temporary return of the jaundice lasting a few days probably because of a temporary blockage of the tube.

**CASE 6** A woman aged 41 had had cholecystectomy elsewhere with removal of many gall stones in February, 1914. In March 1925 she had pain in the upper abdomen followed by jaundice for 2 or 3 days. A second attack occurred a week later and thereafter one occurred every 3 or 4 days. Morphine was required at times to relieve the pain.

Examination revealed slight jaundice. A diagnosis was made of recurring cholecystitis with stone in the common duct. At operation a stricture of the common duct 1 centimeter in length in the region of the cystic duct was found. The gall bladder was about 1.5 centimeters in diameter and did not contain stones. The stricture was cut and a reconstruction of the common duct was made over a McArthur catheter the lower end extending through the duct into the duodenum and the upper into the hepatic duct. The patient made a satisfactory recovery and has had no further colics or jaundice (Fig. 6).

**CASE 7** A man aged 65 had had gastric fullness 2 hours after meals for 2 years. Painless jaundice had begun in April 1924. He had lost 20 pounds and also much strength. Because of his poor general condition with the history of a painless jaundice it was decided to keep him under observation for a time before making a definite diagnosis.

The patient returned to the clinic June 24 1925 on account of an attack of excruciating pain in the region of the gall bladder which had lasted for 1 week. Jaundice had decreased in intensity since then. A diagnosis of cholecystitis and stone in the common duct was made and at operation a greenish gall bladder an impacted stone in the cystic duct enlargement of the common duct and dilatation of the ampulla were found. The gall bladder was perforated but the perforation was protected by omentum. A cholecystectomy and choledochostomy were performed. The patient recovered from the operation and has remained well (Fig. 7).

**CASE 8** A woman aged 46 had had gall stone colics for 21 years. Ten years previously following a colic she had had slight jaundice which disappeared. Although she had frequent colics during the last 10 years there was no evidence of jaundice. In the latter part of July 1925 she had had a similar attack of colic accompanied by fever of 102 degrees but no jaundice.

A diagnosis was made of chronic cholecystitis with cholelithiasis. At operation several stones were found in the common and hepatic ducts and removed. The gall bladder containing stones was removed. The patient recovered uneventfully.

**CASE 9** A woman aged 37 had had gall stone colics requiring morphine since July 1923 with indigestion between attacks. Jaundice appeared in May 1925 following a severe attack of gall stone colic. The colic recurred in September and the jaundice increased in intensity. A dull aching pain in the region of the gall bladder had continued.

Examination revealed jaundice 4 serum bilirubin 7.9 milligrams and a coagulation time of 12 minutes. A diagnosis was made of biliary obstruction resulting from gall stones. At operation a subacutely inflamed gall bladder was found. It contained several stones two of which had perforated posteriorly into the liver forming two pockets communicating with the lumen of the gall bladder. A single stone approximately 1.5 centimeters in diameter was removed from the common duct. Stones were removed from the gall bladder and drainage instituted. Good recovery followed.

**CASE 10** A man aged 50 had had intermittent attacks of painless jaundice with light colored stools between July 1923 and November 1925. Jaundice lasted for 2 or 3 weeks sometimes accompanied by fever then both would subside.

In July 1925 examination revealed a palpable gall bladder. The patient returned for observation in October 1924 with history of recurrence of the jaundice 3 weeks previously. The distended gall bladder was still palpable. In November 1925 he returned for examination stating that the last attack of jaundice had been present for 2 months with loss of weight and fever varying from 99 to 102 degrees daily.

Examination revealed jaundice 2 temperature 100.5 degrees and a distended gall bladder. Be-

cause of the intermittent character of the jaundice and fever and the long period of time elapsing since its onset exploration of the biliary tract and pancreas was advised. A mass was found at the head of the pancreas producing distention of the biliary tract. An anastomosis was made between the gall bladder and the stomach (cholecystogastrostomy). The patient withstood the operation satisfactorily and a month later his jaundice had disappeared he had regained his appetite and was regaining his strength. It was difficult to tell from the consistency and contour of the mass at the head of the pancreas whether it was due to pancreatitis or malignancy.

CASE 11. A Syrian woman aged 40 had had a history of pain in the area of the gall bladder for 10 years. Cholecystectomy with removal of four stones was performed in August 1924 elsewhere. Four months later the dull steady pain again appeared with attacks of colic sometimes accompanied by jaundice. The pain was under the right costal margin and at times extended around the ribs to the back.

At the time of examination the attacks occurred every 2 or 3 days at times with nausea and vomiting. The van den Bergh test for bilirubin in the blood showed 0.7 milligrams in 100 cubic centimeters. Exploration of the common and hepatic ducts and pancreas was performed December 17 1925. There were slight adhesions and the common duct was enlarged even more than it should be after the removal of the gall bladder. It was difficult to pass a scoop through the common duct at first but finally a large scoop was passed. The adhesions around the duct were separated and a small drain was inserted in the hepatic duct. The patient left the hospital in good condition.

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On examination the patient was found to be jaundiced and tender in the right upper quadrant of the abdomen. A diagnosis of common duct obstruction was made with a 50 per cent chance of a malignancy. At operation a distended gall bladder and common duct were found. Impacted in the ampulla was a mass of putty like stony material approximately 1.5 centimeters in diameter. It was so firmly fixed that a trans duodenal exposure at the papilla and an opening in the common duct were necessary in order to remove all the fragments of stone. The gall bladder was filled with stones and thick caramel colored bile. The gall bladder was removed and a catheter placed in the common duct. The opening in the duodenum was sutured. The pancreas was apparently normal and there were no other stones in the hepatic duct. The patient's convalescence was satisfactory until the ninth day when following the removal of a gauze drain a hemorrhage occurred from the drainage tract. This ceased during the next 12 hours. Three days after the first hemorrhage a second occurred which necessitated blood transfusion and packing of the operative area with gauze.

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## THE USE OF RADIUM AND X-RAYS IN THE TREATMENT OF MALIGNANT DISEASES OF THE PARANASAL SINUSES<sup>1</sup>

BY DOUGLAS QUICK, M.D. (TOR.) F.A.C.S. NEW YORK

Att. d. S. 600 M. M. Hospital

**A**CCURACY in details is essential to proper application of radium and X-rays in the treatment of malignant diseases. The histological structure of the tumor, its size and shape, its relation to adjacent structures, particularly bone and the presence or absence of infection must all be considered.

Probably no location in the body presents so many complicating factors as the paranasal sinuses. A wide range of tumor type is possible. The primary site of origin is often difficult and frequently impossible to determine. The invasion of adjacent soft parts, bone and cartilage and sinuses is hard to define. Interference with sinus drainage and infection gives rise to inflammatory tissue, which it is often impossible to differentiate clinically from tumor tissue.

The peculiar anatomy of the paranasal sinuses favors inflammatory processes. Just how much this has to do with the original cause of many of the growths is not known. Certainly it is an important factor. Inflammatory

processes alter the normal type of tumor growth and influence unfavorably the protective cellular reactions in surrounding normal tissues.

The complex embryology of the parts under discussion affords opportunity for tumor origin from many developmental anomalies. Hence a wide range of tumor type is met with.

Inasmuch as malignant growths of the maxillary antrum predominate, it is perhaps best for the purposes of the present discussion to center around this group. Whether most of the tumors referred to as antrum growths are primary or are secondary extensions from other sinuses or the nasal passages is frequently not understood. Inflammatory processes often make the true picture. In our own experience these cases are usually so far advanced that the exact site of origin cannot be determined with any degree of accuracy.

Carcinoma is the predominating type of growth. A cylindrical cell carcinoma of adenocarcinomatous structure is most com-

mon in all of the sinuses. It is rapid in growth, bulky and bleeds easily. It invades bone readily or may erode it from pressure. Consequently with this type of tumor in both antrum and nasal passage it is impossible to determine the primary origin. Squamous cell carcinoma usually represents secondary invasion of the antrum but may arise there primarily from lining membrane cells altered or flattened by some previous inflammatory processes.

Certain basal cell tumors arise in the antrum: adenoid cystic epithelioma, cylindroma and endothelioma. These are usually of dental origin and are easily identified by their relation to the teeth. They are altogether less malignant and of slower growth than other types but are not usually recognized until late.

Most of the so called sarcomata of the antrum are in reality round cell carcinomata of atypical structure, the result of chronic inflammatory changes in the lining mucous membrane.

True sarcoma of the antrum and nares is usually angiosarcoma or myosarcoma. Osteogenic sarcomata are rare but are easily recognized either radiographically or histologically.

Mixed spindle and round cell sarcomata of the turbinates so called fibrosarcomata are not uncommon. Chondromyosarcomata of the vault of the pharynx are met with occasionally in children.

Lymphosarcoma may appear at almost any point in the paranasal sinuses but is practically always only a part of a more generalized disease. It is not improbable however that this disease frequently has its origin in the lymphoid tissue of the postnasal space. Its invasion of the sinuses therefore is from behind forward. Its rate of growth is so rapid that the exact origin can only be guessed at.

Essentially benign tumors do not come within the scope of this paper. Mention is made simply to say that they are purely surgical problems. If radium is used its caustic action must usually be employed and this element makes it too dangerous to be used in benign tumors.

The symptoms and clinical course of malignant diseases of the paranasal sinuses are too well known to merit discussion here, except for emphasis on one point. (I realize that I am dealing with the problem from the standpoint of one treating malignant diseases rather than as a nasal specialist. Yet I do not believe much time elapses between the making of a diagnosis by the nasal specialist and reference to us for treatment.) The cases are almost invariably far advanced. It does seem that they are considered inflammatory for too long a period and that biopsy or earlier surgical exploration of more sinuses would result in a saving of many of these cases.

Mixed infection with the resulting inflammatory processes not only complicates diagnosis but makes definition of the tumor bearing area uncertain. It adds to the surgical risk. It aggravates tumor growth. Osteomyelitis almost invariably accompanies tumor invasion of bone. It interferes with the reaction of the normal tissues about the growth to the physical agents. More of these cases succumb to fatal infection than to the natural progress of the disease.

A review of the literature reveals rather few favorable results in the treatment of adult types of malignant growths in the sinuses. This is not surprising when we realize that surgical principles as applied elsewhere can rarely be applied in the treatment of accessory sinus growths except perhaps in excision of the upper jaw for early growths in the maxillary antrum without bone invasion.

During the past few years radium and X-rays have proven of value in dealing with this group of cases. These physical agents however have their drawbacks and shortcomings just as surgery has in such a complicated group of diseases.

In our experience a combination of surgery, radium and X-rays offers most. We believe that radium and X-rays are capable of eradicating the tumor tissue if the radiation is delivered uniformly throughout the growth and in sufficient amount depending upon its exact type. In order that this may be accomplished it is frequently necessary to



expose the growth surgically. Still more frequently it is necessary to provide surgical drainage of the part or as in the antrum to remove the bulk of tumor tissue after radiation in order that more active infection in breaking down tumor tissue may be avoided. In other words we depend upon the physical agents to deal with the new growth directly and surgery to provide access and drainage. If radium is to be placed accurately the surgical exposure must be adequate. We are strongly in favor of large openings wherever possible. In exposing the antrum from below the floor and anterior wall should be removed. Such an opening gives free access and can be readily closed later by an obturator on a dental plate. If the floor of the orbit is invaded the eye should be sacrificed promptly and free access afforded in this way from above. We must remember that we are dealing with a lethal disease and that conservative measures may postpone treatment in some unsuspected and inaccessible area until it is too late.

In our experience X rays alone are not sufficient to control the growth in the paranasal sinuses except perhaps in the cases of such unstable tumors as lymphosarcomata. They are however of very great assistance, and this is particularly true since the advent of shorter wave length rays. We use X rays for practically all of our external radiation. Kadium is of course the agent for direct application to or into the growth. The exact method depends upon the individual case but in principle it must be applied accurately and uniformly throughout the tumor and in sufficient amount to produce a maximum reaction consistent with the viability of surrounding normal tissues.

For this purpose we have for several years employed bare tubes of radium emanation very extensively. During the past year we have found it possible to prepare in our physical laboratories gold emanation tubes scarcely larger than the 'bare tubes' or glass emanation tubes. This gives us all of the advantages of bare tubes minus the beta radiation. In other words it affords a means of burying filtered radium emanation obtaining a prolonged internal gamma radiation

and avoiding the severe inflammatory reaction due to beta rays.

We depend upon these small tubes of radium emanation buried uniformly throughout the growth for the major part of our radiation. We use them invariably in the antrum. In some other locations such as the turbinates it is possible and practical to insert metal needles containing either element or emanation. Since we have been able to replace unfiltered by filtered capillary emanation tubes our tendency has been more and more to vary discontinuing the use of needles. The small emanation tubes can be more accurately placed. Distribution is more uniform. They stay in place exceptionally well. Inasmuch as the dose is prolonged to at least 14 days of active radiation it can be very appreciably increased. There is ample reason to believe that the prolonged dose is more efficient than a comparable amount given over a shorter period. The trauma of introduction of capillary tubes is less than with needles.

Occasionally it is possible to place filtered tubes of larger size in rubber tubing either singly or in tandem and to pack them firmly in place at some point along the nasal passages.

A very efficient radiation of the postnasal space may be obtained by placing a bulb of emanation in a small hollow metal sphere as a filter this being wrapped with gauze to lend proper distance and drawn up into the postnasal space by means of a string previously passed backward through the nares. The type of bulb we usually employ for this is filtered by 0.4 millimeter gold platinum alloy and is about 8 millimeters in diameter.

These special applicators however must be devised to suit the individual case. The only standard form of radium application which we employ is the interstitial implantation of gold capillary emanation tubes.

The internal applications are almost always supplemented by external doses of X rays or filtered radium or both.

Radium applied within the sinuses produces an inflammatory reaction in the soft parts which increases the danger of infection. Hence adequate drainage is doubly indicated. It also has a devitalizing action on bone and

cartilage if closely approximated in large doses. Bone necrosis from this cause is much less frequent since we have eliminated unfiltered emanation but it is still a factor.

Since the majority of the growths under consideration are in or extend into the antrum it may be well to outline briefly our exact procedure in treating them. External radiation with both short wave length X rays and heavily filtered radium is applied over the antrum and adjacent parts. This produces a marked inhibition of tumor growth. We use both X rays and radium for this because we feel that by varying the quality of radiation larger doses can be given with better clinical results. Following the external treatment capillary gold emanation tubes are inserted directly in the tumor through its ulcerating surface or the point of bone necrosis and left in place. If tumor tissue is present in the nasal passage it is treated likewise. From 10 to 15 tubes of 10 to 3 millicurie value are used the number depending on the size and extent of the tumor. Ten days to a fortnight later the antrum is exposed widely by removal of its floor and anterior wall and the tumor bearing area cleaned out as carefully as possible. When the packing is introduced a bulb of filtered radium is put in with it at the central point of the cavity or in another location according to the local conditions which obtain. Usually a dose of 5 to 40 millicurie emanation is used for this purpose and is removed with the packing at the end of 48 hours.

If the tumor has invaded the orbit we remove the eye so that access may be had from both above and below. Such a procedure may very well be considered mutilating but in our experience has proven to be well worth while. It provides the only means of accurate radium application and in addition facilitates drainage. We have failed in a number of cases by attempting to apply radium through the antrum and nasal passages after growth had extended into the orbit.

The procedure which I have outlined thus far applies of course to the case in which we feel we have a reasonable chance to control the growth completely.

If the patient's general condition is poor or if the growth is very extensive invading the

orbit ethmoids and possibly the sphenoid cells or if inoperable cervical metastases are present then nothing but palliative measures should be considered. For this external radiation plays the greater part. Small amounts of filtered interstitial radiation may be employed at times but always with caution.

As for the choice of method in removing the radiated tumor tissue I believe there is rather little to be said. We depend upon radium and X rays to devitalize or destroy the growth. The only points to be considered in removing it are simplicity and a minimum of trauma. The use of scalpel and curette is bloody and necessitates too much manipulation of tissue. The old fashioned cautery is clumsy and brings in the factor of too much heat. The same may be said of the use of soldering irons except that small ones are not as cumbersome to handle. We have found that coagulation of the entire area by means of the high frequency cautery and removal either with curette or the high frequency cutting needle furnishes the desired result with a minimum of trauma. It can be done very satisfactorily under local anesthesia.

So far I have made no reference to the treatment of metastatic cervical nodes secondary to the various types of carcinoma encountered in the paranasal sinuses. For these we follow the same procedure as has previously been outlined for metastatic nodes secondary to intra oral carcinoma that is a combination of X rays, radium and surgery.

All necks are radiated with short wave length X rays. If no nodes are palpable the case is kept under careful periodic routine examination. If an enlarged movable node with presumably intact capsule is present on admission or appears later the X radiation is supplemented by radium packs and following this a unilateral dissection done under local anesthesia. Radium emanation is always buried in the wound at the time of the surgical dissection. If the metastatic node has perforated its capsule and the infiltrating growth is fixed in adjacent structures we class the case as inoperable. External radiation is continued and emanation tubes implanted in the mass as a palliative procedure but no dissection is attempted. Likewise if the

primary growth is far advanced but with an otherwise operable neck we treat the neck as well as the primary mass in a purely palliative manner

If the primary growth in the sinuses is of basal cell type no attention to the neck is necessary because the tumor does not metastasize. If the primary growth be a lymphosarcoma no surgery is indicated in the neck. It is a disease which extends widely and rapidly and as for any single local manifestation it can always be managed better by the physical agents than by surgery. As for the true sarcomata occasionally met with in the sinuses I am of the opinion that no surgery is indicated when metastases are present. They are too apt to be multiple and had best be treated by radiation.

In reviewing our clinical material relative to this subject I have been more forcibly impressed than ever with the advanced character of practically all of the cases. The majority is classed as carcinoma of the antrum with extensive bone destruction and the nasal passage partially or totally occluded by tumor tissue. In these it is impossible to determine in which sinus the growth was primary.

Of 100 cases treated between 1916 and the present time all but 28 patients were beyond the hope of anything except palliative measures. In 7 of these 8 cases the eye was removed and the antrum cleaned out from below. Of the total group 50 patients are known to be dead, 22 have been lost track of and are therefore assumed to be dead, 7 cases are too recent to classify and 15 present no clinical evidence of disease.

The duration of freedom from clinical evidence of disease in these 15 cases is as follows:

- 1 case 7 to 8 years
- 1 case 4 to 5 years
- 1 case 3 to 4 years
- 5 cases to 3 years
- 4 cases 1 to 2 years
- 2 cases 9 to 12 months

Of the 7 cases with removal of the eye in addition to operation through the mouth patients are well after 1 year, 1 is well after nearly 2 years, 1 was recently treated and 3 died.

In the group of 15 cases clinically free from disease 11 were of carcinoma and 4 of sarcoma.

We have seen only 1 case of primary carcinoma of the frontal sinus. This patient is now well 6 years after surgical exposure and radiation directly within the cavity.

One very unusual case of lymphosarcoma which had extended well into the antrum and orbit has remained well nearly 7 years following external radiation, removal of contents of orbit, antrum and ethmoids and intensive radiation within the cavity.

### CONCLUSIONS

1. Surgical exploration of the paranasal sinuses and biopsy should be resorted to earlier and more frequently so that earlier diagnosis of new growths may be made.

2. With few exceptions the principles applying to surgical removal of cancer in general cannot be carried out in dealing with growths in the paranasal sinuses.

3. Radium and X rays are of value in treating this group of cases but except in palliative procedures must be used in conjunction with surgery.

4. Radium and X rays may be depended upon to eradicate the tumor tissue if applied accurately and uniformly throughout the growth in sufficient dosage.

5. Surgery must be employed to provide exposure for radium application and adequate drainage.

6. The anatomical relations of the parts are such that infection is a much greater menace here than in new growths in most other locations.

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### DISCUSSION

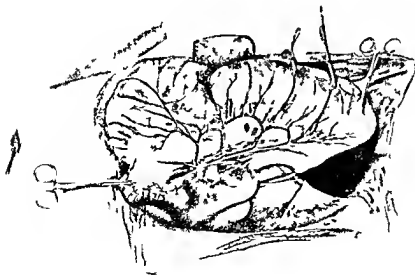
DR G. E. FAHLEK. The results obtained from radium and X ray in the treatment of paranasal

sinuses would probably be less discouraging if the diagnosis could be made at an earlier stage when the disease is not so extensive and thorough and radical combination treatment could be applied. Toward earlier diagnosis I would urge that every rhinologist keep in mind the possibility of malignant disease and when in doubt have an X-ray study made. This X-ray study should be very thorough otherwise it may be misleading. The extent of invasion and often the extent of the associated exudative and inflammatory processes can be determined. An X-ray study will show that in malignant disease the septa and walls of the sinuses are destroyed. This destruction has a different appearance from the destruction caused by a pyogenic process. The destructive process would resemble only a very acute stage of a pyogenic process in the acute inflammatory processes the diagnosis of malignant disease would not have to be considered. In the chronic inflammatory processes which are the type to be compared with malignant disease destruction of bone is associated with a defensive process on the part of the organism indicated by sclerosis associated increased density at the border of the destruction and thickening of the cell walls. The opacity of the sinuses is also demonstrated together with the erosion of the walls or pressure of the walls. If the growth is relatively benign there may be pressure and displacement effect from the growth.

If the diagnosis is still doubtful a section should be removed for microscopical study. The operation should be an open one with a wide opening through the face rather than through the mouth not only for the reasons already given but for the sake of having the drainage which occurs in connection with the sloughing process outward instead of in the mouth and throat. I believe that the best method of destruction is by means of the radiotherm or electrocoagulation equipments. Especially in those cases in which there is considerable pain I would urge that preliminary to any destructive process the patient have a ligation of the external carotid to control hemorrhage and at the same time a resection of the fifth nerve. In this way the subsequent operative procedure can be carried on without an anæsthetic and practically without hemorrhage.

I would urge with regard to radiation that before the operation the patient be treated by high voltage X-rays from every angle by cross firing upon the disease and that this treatment be very thorough preferably given daily and so controlled and measured as to do no harm but to deliver the maximum quantity into the diseased tissue.

At the time of the operation I believe that it is advisable to use filtered radium rather than radium seeds for the sake of eliminating further necrosis and of getting a more distant effect on the cells that might still be invaded by the malignant disease.



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THE VALUE OF PERITONEAL SHEETS OF CONSCIENCE IN ABDOMINAL SURGERY<sup>1</sup>BY DR. ALBERTO CUTIHERREZ BUENOS AIRES, ARGENTINA  
CL O R G U

THE peritoneal sheets of conscience are remarkably serviceable in abdominal surgery. It is through them that certain fixed segments of the digestive tract may be made movable. Intestinal mobilization (the term mobilization will be used in the sense of making a portion of the gut freely movable) represents the preliminary and fundamental element in every surgical intervention on an intestinal segment that has become secondarily fixed by the process of coarctance.

## EMBRYOLOGY

The primitive alimentary canal of the early embryo is a comparatively straight simple tube occupying a mid sagittal position. In the abdominal region the canal lies within the body cavity (coelom) which is lined by parietal peritoneum. The visceral peritoneum is reflected from the mid dorsal line as a double layer: the dorsal mesentery which extends to the caudal end of the digestive canal. This is divided into the dorsal mesogastrium (which becomes the greater omentum), the mesoduodenum, the mesentery and the mesocolon which support respectively the stomach, duodenum, small intestine and the colon. The vessels and nerves pass within these to the canal. The spleen and pancreas are in the dorsal mesentery.

Cranially and anteriorly there is a primitive ventral mesentery containing the liver from which the falciform ligament of the liver and the lesser omentum are derived.

The stomach undergoes a rotation on its longitudinal axis so that its anterior border (lesser curvature) is directed upward and to the right and the posterior border (greater curvature) inferiorly and to the left. The surface, hitherto so to face anteriorly and posteriorly rather than laterally. The caudal end of the stomach and the terminal end of the gut are displaced to the left of the mid line while the duodenum moves to the right.

The vitelline gut develops in a more complex manner. The portion of the gut destined to become the small intestine and the colon form a loop ventrally with the superior mesenteric artery as an axis directed toward the umbilicus. A rotation of 180° from left to right with the superior mesenteric artery as an axis takes place and thus the proximal limb of the loop becomes the small intestine and the distal limb the colon. This carries the caudal end of the duodenum (third part) to the left of the midline to its position in the adult. The remaining segments of the gut take their re-

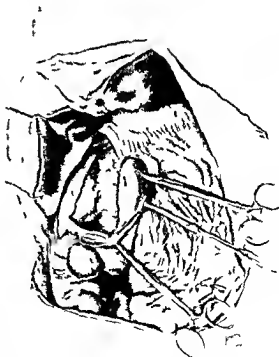


Fig. 1. Mobilization of the first part of the duodenum. The great omentum is shown inferiorly and to the left. The descending portion of the duodenum is reflected to the left by separation of the retroperitoneal sheet running to the right half line and the posterior surface of the first part of the duodenum.

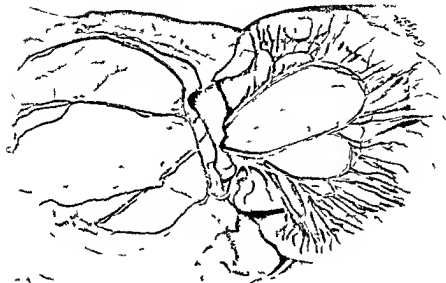


Fig. 6. The cecocolic flexure of the colon has been separated with the colon and the mesocolon placed firmly and the greater mesocolon placed in the position of the greater part of the mesocolon.

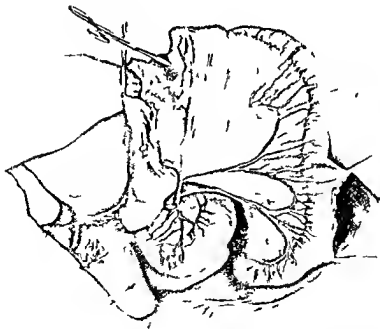


Fig. 4. Mobilization of the ascending colon and the position of the transverse colon. The upper part of the ascending colon and the greater mesocolon have been separated from the body of the uterus.

spective places but at first retain their mesenteries and are freely movable

Fixation follows accommodation with accompanying changes in the mesenteries and peritoneal relations

Of the colon only the transverse segment retains its mesentery the cæcum becomes free and the remaining portions become fixed to the posterior abdominal wall or the underlying viscera. Rarely the ascending and descending colons retain a very short mesentery

Wherever the visceral peritoneum on the mesentery of a portion of the gut is placed in contact with parietal peritoneum or the peritoneum of another organ the mesothelial layers of both are lost and the conjunctiva (fibrous layer of the peritoneum) become fused giving rise to connective tissue sheets known as the sheets of coalescence. Wherever this fusion takes place between the visceral peritoneum of an organ and the parietal peritoneum the organ becomes retroperitoneal

#### THE SHEETS OF COALESCENCE AS A MEANS OF ENTRANCE TO UNDERLYING REGIONS

These sheets do not contain vascular elements or nerves and are therefore especially desirable avenues of approach to the underlying regions

Access to these regions may be gained by sectioning the peritoneum at the line of fusion farthest from the root of the primitive mesentery and reflecting the organ and its vessels toward the midline reproducing the embryonic mesenteries. This makes the segment freely movable (Fig 3)

#### IMPORTANT SHEETS OF COALESCENCE

A brief discussion of the formation of each of the more important sheets of coalescence may serve to clarify their location and to bring out their surgical importance

*The retro duodeno pancreatic sheet of Treitz*  
When the stomach and duodenum rotate the mesogastrium and mesoduodenum containing the spleen and pancreas are carried to the left in such a manner that the left side of the mesentery duodenum and the pancreas are brought in contact with the dorsal body wall. The result of this contact is an absorption of the two mesothelial layers and a fusion of

the connective tissue underlying them. It is therefore possible to remove the duodenum and pancreas from the body wall by splitting this sheet of coalescence without danger of injury to their vessels and nerves (Figs 2, 4, and 6)

*The colo epiploic sheet*  
As the dorsal mesogastrium develops into the great omentum and comes to lie over the transverse mesocolon the colon at this time having assumed a transverse position the upper portion of the posterior layer comes in contact with the anterior layer of the transverse mesocolon and fusion occurs. Here there is formed a sheet of coalescence which may be taken as a route to the posterior wall of the stomach and the anterior surface of the pancreas without destruction of vessels. The advantages of this means of approach to the stomach in doing gastroenterostomies will be discussed later

*The posterior duodenal sheet*  
The rotation of the duodenum to the right and its subsequent opposition to the anterior surface of the right kidney and the inferior vena cava results in the formation of a retroduodenal sheet which makes possible the reflection of the descending and transverse portions of the duodenum to the left with an exposure of the hilus of the kidney and the posterior surface of the duodenum (Fig 1)

*The sheet of coalescence of the lower ileum and ascending colon*  
After the cæcum and lower portion of the ileum shift to the right inguinal region the ileum and occasionally the cæcum become fixed to the posterior abdominal wall. These portions may be mobilized by reflecting them toward the midline (Fig 5). By carrying the procedure upward the entire ascending colon and the right extremity of the transverse colon may be mobilized. Such an exposure would bring to view the right kidney, descending and transverse parts of the duodenum, head of the pancreas, ureter, internal spermatic artery, and the inferior vena cava

*The retrocolic sheet of Pierre Duval*  
The descending colon and frequently the iliac portion of the sigmoid colon become fixed to the posterior wall forming the retrocolic sheet of Pierre Duval. The reflections of these segments of the gut to the midline expose the structures lying on the left posterior abdominal wall (Fig 3)



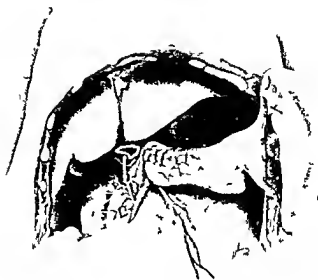


FIG. 5. Mobilization of the spleen and pancreas (S. G. 1921).

#### THE APPLICATION OF A KNOWLEDGE OF THE SHEETS OF COALESCENCE TO SURGERY

Through a knowledge of these sheets the various fixed sections of the alimentary tract may be made movable and the operative technique in abdominal surgery thus simplified. After the fixed portions of the gut are freed they may be brought to the surface of the abdomen; this facilitates the execution of the most difficult details of section and anastomosis and at the same time diminishes considerably the danger of contamination of the cavity.

Mobilization of the duodenum greatly simplifies investigations for concretions at the retropancreatic choledochus and the gastro-duodenostomy of Villar Finney or any gastric anastomosis especially that of the end to end type after pylorotomy.

In operations for the reduction of fixed hernia of the ileo cæco colonic segment or of the sigmoid colon the preliminary step is mobilization of the gut.

When the cæcum has secondarily become fixed and the appendix is retrocæcal to expose it it is necessary to free the cæcum and the lower portion of the ascending colon.

Kidney and other retroperitoneal tumors may easily be operated on by the abdominal route if the colon is first made mobile (Figs. 2 and 3).

Commonly the spleen remains mobile in the left wall of the omental but its mobility being limited by the lienorenal and splenopancreatic ligaments posteriorly (Fig. 5) and the gastrosplenic ligament anteriorly. It sometimes occurs that the fusion of the posterior mesogastrium with the parietal peritoneum of the posterior wall extends so far to the left that the spleen is partially fixed. Donald Balfour of Rochester for several years has taught that in the cæca is the operative technique of splenectomies may be simplified by mobilization of the fixed portion of the spleen.

Since 1921 I have mobilized the tail of the pancreas and spleen in these operations.

Excellent methods have been described for mobilization of the head of the pancreas in the execution of duodenopancreatic pancreaticotomies. These do not apply to operations on the body of the pancreas which have been effected without any specialized method. As has been pointed out it is possible to reach the

body of the pancreas by splitting the colo epiploic sheet of coalescence (Fig 6)

Separation of the colo epiploic sheet offers great advantages in gastric surgery in fact once the separation is effected and the omental bursa is opened the entire posterior surface of the stomach is exposed It is then possible to discover and suture gastric perforations Adhesions of the stomach to the anterior surface of the pancreas may also be isolated

It is easier in gastro enterostomies to take the jejunum through a mesocolic rent to the stomach after the colo epiploic sheet is separated than to carry a portion of the posterior wall of the stomach through the transverse mesocolon to the jejunum as in the classical method for very often the gastric cone that is exposed is too high above the pylorus In such cases one of the fundamental precepts of surgery is violated, the stoma being too great a distance from the pylorus

## A STUDY OF THE INFLUENCE OF PROTEIN THERAPY ON EXPERIMENTAL STAPHYLOCOCCUS INFECTION OF THE CORNEA OF THE RABBIT<sup>1</sup>

By BEN WITTKEL MA MD FACS NEW YORK

I FEEL that it may be fitting and opportune at this time to discuss a phase of the subject of protein therapy not heretofore referred to or discussed in connection with this work but one however which is of especial importance in arriving at conclusions about it I refer particularly to the study of the influence of protein therapy on experimental staphylococcus infection of the rabbit's cornea which of course must be regarded as fundamental in theory and in the practice of protein therapy

I shall not review the history of this therapy or discuss the theory of the non specific reaction and its probable mechanism of effect Nor will I touch upon the now changing standards of immunity in this connection Nor can I but refer to what is known today as colloid chemistry and the 'colloidal state' of given substances (according to August Lumiere and Kopaczewski) Although these theoretical and chemical phases of the subject are of intense interest and we hear recently from Professor Lumiere that the mechanism of the mysterious colloids holds in suspense the future progress of biology the time allotted to me will not permit more than a passing reference to these phases

In this field of research the principles are no longer recognized as entirely opposed to

the accepted standards of bacterial activity, of specificity and immunity This status has come to pass through the pressure of insistent demand on the theorist by the accumulating evidence of clinical results in human and in animal experimentation Although Ehrlich's side chain theory may best explain the specificity and mode of action of various antibodies there is a growing tendency to explain many of these reactions on a physicochemical and colloidal basis Antigens are substances that cause antibodies in the body fluids And without exception antigens are colloids and are usually protein in nature Furthermore antibodies are colloid in their chemical characteristics, while they may or may not be solutions of colloids they are in the final analysis products of cellular activity and therefore derived from colloidal solutions (colloid dispersions)

Now since there is no longer any doubt that the positive systemic reaction to protein injection is a valuable therapeutic measure it has become a matter of some debate as to the relative value of different forms of protein or different preparations of the same form Also the problem of dosage and the timing of the injection in relation to other treatment offers a field for investigation which up to this time has not even been approached

In respect to the former that is to the selection of the most suitable highly potential protein available antidiphtheritic serum as it is now prepared offers perhaps the best form of foreign protein for administration to the human. Because milk varies in its potential and toxic action numerous commercial preparations are now undergoing experimentation. Normal horse serum "Aolan" "yatsencasein" "Ciba" (cibalumin, aseptic solution of egg albumin) albumose proteose non specific vaccines etc have not as yet been shown to possess with any certainty a more reactive and potential effect than has anti diphtheritic serum. Aolan has been heralded as a preferable form because it does not produce a systemic reaction. This is strange since a positive systemic reaction that is to say a moderate rise in temperature et cetera, is necessary in order to establish the pre anaphylactic stage of hypersensitivity and thereby increase resistance which is believed to be the therapeutic effect. Furthermore the dosage and reaction of other preparations are uncertain. The dosage of the serum is certainly more definite and its anaphylactic effects are more clearly understood. Banzhaf's method of preparing the serum by isolating the antitoxin globulins permits the use of a concentrated serum which lessens the incidence of serum sickness and facilitate the administration of large doses. According to Park this method gives a concentration of about six times the original potency. Danier Frogier and others claim to have shown that it is ten times more potent than normal horse serum which may be due not only to its high concentration and method of preparation but also perhaps to the constituents attributed to the diphtheria bacillus or toxin.

Moreover the theory as to the properties and structure of antibodies in immunity lends striking evidence (Vaughan Kraus Ichikawa Ludke) that there may be a direct antagonist a special antigen or protein (globulin) in the serum more active than a mere animal protein (milk egg albumin) the method of concentration of the serum adding to the concentration of the antibody elements in the serum. If there is any virtue to be had in the non specific diphtheritic elements (colloids)

in the serum there is a decided advantage and preference in antidiphtheritic serum over other forms of proteins employed in this therapy. Furthermore the facility of obtaining and administering suitable doses of anti diphtheritic serum is a distinct advantage not to be overlooked.

As for anaphylaxis a concentrated serum is not so likely to produce serum sickness as whole serum since a smaller quantity of it is injected. The history of previous anaphylactic conditions previous diphtheria status lymphaticus asthma or hayfever like attacks in persons proved susceptible in a stable and horse environment are well established as probable contra indications to serum injections. I have not observed serious anaphylactic effects in any case (now 170 cases treated) and doses have varied from 1 000 to 5 000 units, a total in one case of 12 000 units (given in 3 000 and 2 000 unit doses). The doses are pitifully small when contrasted with those frequently given even for prophylactic purposes in diphtheria (5 000 to 10 000 units) not to mention those employed for the full therapeutic effect (10 000 to 20 000 units). Verhoeff recently reports the injection of 20 cubic centimeters (about 16 000 units) every day for a period of about a month in a case of sympathetic ophthalmia in which case he claims a cure. My own experience however has taught me some respect for the highly potent effect of anti diphtheritic serum and also that small doses of 3 to 4 cubic centimeters (2 400 to 3 000 units) are harmless and yet are sufficient to produce moderate systemic reaction just short of anaphylaxis. It is well known that infections probably represent either an increase of pathogenic power on the part of certain micro organisms or a disturbance of the defensive mechanism of the host whereby the normal relations are disturbed and micro organisms that normally are harmless become infective and disease producing. The severe general reactions observed in acute anaphylaxis and after the first intravenous injection of a foreign protein differ both theoretically and in their manifestations yet in a sense the results are not dissimilar. In anaphylaxis a sublethal dose given to a sensitized animal leaves it immune

to the toxic protein for a definite period while, in the second instance following a sharp general reaction there is frequently a marked improvement of the infectious process. In both instances there is an increased resistance to the action of the toxic agent, and the good results observed following non protein injection may be an expression of the increased cellular resistance observed in the stage of desensitization in anaphylaxis; in other words the cells have been made more resistant to the infectious agent by the foreign protein.

The time of injection and the size of the dose have been given much consideration and have been referred to with some emphasis in my previous reports. The matter of anaphylaxis is of importance in this regard because sufficiently large doses are essential just as they are in the treatment of diphtheria in order to produce a suitable reaction and effect. This is necessary because the serum is almost immediately effective (ten minutes after injection Rosenau) and this stage of pre-anaphylactic effect representing the incubation period of disease is the period of gradually increasing sensitivity of the body cell to the protein or disease element (bacteria) as a measure of body defense against the invader. The first stage of anaphylaxis is known to be one of exhalation and stimulation followed by one of depression paresis arrest of breathing etc. For this reason it is my practice after cauterizing an active ulcer of the cornea to have the serum injected as soon as possible. For the same reason we find an explanation for the constant observation that the effect of the serum is manifest always within 24 to 48 hours after injection the time of hypersensitivity and cellular reaction. It is clear therefore that the time of the injection is important as well as the size of the dose and the relation to local treatment.

In this connection I believe it is generally recognized that a case of hypopyon keratitis in a strong healthy young individual is rarely seen and when such cases are observed intensive local measures alone quickly yield the usual good result. On the other hand we find serpiginous ulcer of the cornea occurring commonly in the aged and in debilitated individuals usually following upon the neglect

of a local injury and the center of the cornea the area least protected by systemic resistance is the area almost invariably affected. Here the problem of cause and effect is obvious. The question of virulence of the infecting micro organism on the one hand and the defensive powers of the host on the other is evident.

In an effort to secure a fixed virus of staphylococci by standardizing the virulence of a certain strain through 'passage' and then by suitable dilution of this virus I have attempted to obtain that dilution which will produce by puncture of the corneal stroma the slightest but active ulceration of the punctured area. It is clear, that by this more certain means of standardizing the virulence and controlling the dosage of the infecting micro organism the matter of resistance becomes the more direct unknown quantity in the problem of cause and effect. It was found that these dilutions varied greatly with the different strains of staphylococci taken from various parts of the body the most virulent strains being those taken from the eye. The dilution was as great as 1:30,000 (or cubic centimeter of bouillon culture of staphylococci diluted in 300 cubic centimeters of normal salt solution) in order to secure the minimum dosage that would produce the slightest but active ulceration of the rabbit's cornea. (One colony of the 24 hour culture of staphylococci in 10 cubic centimeters of bouillon was cultivated for 24 hours when 0.1 cubic centimeter of the bouillon was diluted in 300 cubic centimeters of normal salt solution thus making a dilution of 1:30,000.)

The practical value of this is evident in this study because we are able thereby to observe the relative value of different forms of protein as well as the dosage necessary to produce the therapeutic effect, and from this one can more definitely measure the resistance of the animal to the inoculation. Furthermore it makes one realize how minute must be as a rule the average quantity of micro organisms first infecting the eye in a clinical case of hypopyon keratitis or even in a penetrating wound, and therefore if a highly potent protein can be injected before the infection has become overwhelming a satisfac-

tory result, which otherwise may have been a calamity is deserving of our knowledge of these facts

Now with these theoretical and clinical phases of the subject in mind the problem as it presents itself at this time is first to determine the relative value of injections of antiphtheritic serum and normal horse serum concentrated in the same manner and containing the same nitrogen content and thereby to elucidate the question of the immune body as a possible potent influence in the therapeutic reaction (para specific effect?) second to determine the relative value of different forms of protein (animal vegetable and bacterial) especially as to milk, cod liver oil, hemp extract, typhoid vaccine and tuberculin (TO) as they affect staphylococcal and pneumococcal infection of the refractive media of the eye, third to study the relative value of different methods of injection that is intradermal, subdermal intramuscular and intravenous, fourth to demonstrate a maximum and minimum dosage in relation to the time and character of the infection and fifth, to determine the effect of previously injected immunizing doses for prophylactic purposes

Now in so far as animal experimentation is concerned only a small part of the whole problem can be dealt with at one time and yet each experiment carries with it many factors entirely separate in importance but each dovetailing finally into a more complete analysis and conclusion

With this in mind I have during the past 2 years confined my study to the inoculation of the true cornea with the staphylococcus pyogenes aureus observing the effects of intramuscular injections of antiphtheritic serum as against concentrated horse serum milk and typhoid vaccine But to pursue such an apparently simple outline of experimentation one finds very soon that many unexpected difficulties arise each of which must be worked out separately—problems within problems for example the method of inoculation standardizing the virulence of the micro organism the correct dilution of the fixed virus, similarity of the animals dosage of the protein injected, and many others of less importance

In this series of 26 experiments it was necessary to inoculate 94 corneas The same eye or the same animal was not employed when any effect from previous inoculation and possible immunity thereby could interfere in any sense with the correct interpretation of the results The rabbits used in each experiment were about the same within reasonable limits as to size and weight The same number of rabbits were used for controls as were used for injection Usually 6 were inoculated in each experiment 2 being injected with antiphtheritic serum 2 with typhoid vaccine (or milk or concentrated horse serum) and 2 used as controls

In preparing the micro-organisms for inoculation, the culture was always grown on artificial media for 24 hours before inoculation At first the cultures were made from infections of different parts of the body but in the later experiments it was necessary to standardize the virulence of the micro-organism For this purpose a strain from the eye was cultivated and carried along *passu* with a strain from another location for the purpose of studying relative virulence of each strain for corneal substance at the same time both strains were being brought to their maximum virulence for the rabbit's cornea through passage

The method of inoculation was as follows The eye was cocaineized the lid were retracted with the small rabbit speculum the superior rectus was grasped with fixation forceps a small sterile hypodermic needle was introduced into the corneal substance at a point 2 millimeters from the upper limbus carried horizontally by a twisting motion well into the deep stroma and extended for a distance of 3 millimeters to the center of the cornea After turning the needle three times completely around in this punctured wound in order to form a channel of the same size in each instance it was withdrawn dipped into staphylococcus emulsion and immediately reintroduced into the channel or puncture wound as before It was now withdrawn and the needle at once plunged into agar media as a control In the later experiments instead of reintroducing the needle after dipping it into staphylococcus emulsion 1 cc of a

cubic centimeter of the emulsion was injected by means of a finely graduated pipette into the corneal channel prepared by the needle puncture. The latter method proved to be more accurate especially when we were dealing with high dilutions of a very virulent strain of staphylococci.

The method of injecting the protein consisted of inserting the needle into the flank of the animal just in front of the hind legs and carrying the needle forward into the abdominal muscles so that the natural act of jumping might aid in the absorption and rapid assimilation of the protein substance.

The animals were observed daily after inoculation and when necessary the ocular lesion was studied with the Zeiss magnifier for minute changes. Photographs were made in some instances when the observation was sufficiently clear and of some importance.

#### DISCUSSION

A study of these experiments shows the three stages of development which this work has undergone in the effort to secure delicate and accurate tests of the effect of foreign protein injection. The first stage embraces the first six experiments which show the comparative effects of protein injection when an unmeasured dose of staphylococci is used for inoculation but in which nothing as to dosage of injection or delicate difference in effect could be observed because of the very violent corneal reaction due to too concentrated an emulsion of the micro organism. The second stage is observed in experiments 7 to 19 inclusive in which it was recognized that if the minimum dilution of staphylococci that would produce active ulceration of the cornea could be determined more accurate and delicate observations would be forthcoming. The determination of the virulence of the staphylococci for corneal substance was attempted by first growing the micro organism in the eye of an animal the micro organism being recovered and the dilution of this employed for inoculation. But the varying virulence of the different strains of staphylococci isolated from different parts of the body upset this calculation as the experiments included in this stage demonstrate. Therefore

the third stage, which includes the last seven experiments (20-26), deals with the development of a more accurate method for determining the virulence of the bacteria designed to produce more definite bacterial effects. This was accomplished by passing the strains used (one from an acute conjunctivitis the other from an infected throat) through the eye of three successive animals in an effort to standardize the virulence of the micro organism for corneal substance.

The success of the method of inoculation, designed to bring about a definite and consistent corneal lesion other things being equal depends upon two important factors, the introduction of the needle and the application of the same amount of the staphylococcus emulsion in every instance. The first is less important than the second because it is relatively a simple manipulation. When the needle passes into the anterior chamber or comes forward through the surface of the cornea the event is readily observed and felt. In only two or three instances did either of these accidents occur in all the experiments performed and in none of these were the results recorded. The second factor application of the staphylococci proved its importance through the experimental results. The puncture and repuncture method was fairly accurate when a concentrated solution was used 1:100 as in the first six experiments. Obviously when so small an amount of the solution clings to the needle and is thus introduced into the sterile corneal channel it reduces the dosage also by the mere passage of it. In higher dilutions (1:10,000, 1:30,000) this method was found to be uncertain and perhaps inaccurate and for the same reasons as indicated by experiments 13 to 18. In higher dilutions it was found to be more dependable to introduce into the punctured cornea 1/100 cubic centimeter of the emulsion from a finely graduated pipette as noted in experiments 7 to 12. For this reason the latter method was used in the last seven experiments (20 to 26) in which the question of dilution and virulence was being tested.

Dilutions of the staphylococci emulsion varied from 1:100 (used in the first six experiments), to 1:30,000. At first it was

thought that the character of the corneal lesion depended solely upon the dilution. As shown in experiments 11 to 19 it was found that the dilution necessary to produce a definite corneal lesion was dependent upon the virulence of the micro organism.

An attempt was made to obtain a virulent strain by passage of a certain strain through the anterior chamber of the eye experiments 7 and 14. But this was found to be unreliable because one strain proved to be more virulent than the other, and one of them of such low virulence that as shown in experiments 12, 14, 17 and 18, a very small lesion or even no lesion at all developed as a result of inoculation although a dilution of 1:10,000 was used.

Finally, an attempt was made to standardize the virulence of two different strains of staphylococci by passing each strain successively through the cornea of three rabbits. This led to the interesting observation that the staphylococcus from acute conjunctivitis was in every instance more virulent than the strain cultivated from an infected throat as shown in experiments 20 to 26. In experiments 25 and 26 the corneal lesion from the throat culture was not so advanced as that from the eye culture although the dilution of the throat culture (1:1,000) was five times as strong as the dilution of the eye culture (1:5,000). This is certainly definite evidence demonstrated in every instance 30 eyes being inoculated in experiments 20 to 26 inclusive all 15 eyes inoculated from the eye culture showing more marked corneal lesions than the 15 eyes inoculated from the throat culture. Furthermore this observation at once raises the question whether or not any staphylococcus from a corneal ulcer or acute conjunctivitis has greater virulence or specific effect for the cornea of the rabbit and whether or not through 'passage' the virulence of staphylococci from other parts of the body can be raised to a virulence similar to that shown by a strain originally from the eye.

#### CONCLUSIONS

1. Such an investigation as this is dependent for its accuracy primarily upon the method of inoculation, the determination of

a fixed virus through "passage" and the suitable dilution of this virus.

2. The method of injection, the size of the dose and the relative value of different forms of protein should be worked out with some degree of certainty from the outline of procedure finally demonstrated in these experiments.

3. These experiments also argue without variation in favor of that very interesting and important question of virulence of different strains of staphylococci for corneal substance as evidenced by the unmistakably greater virulence of the staphylococci cultivated from the eye as compared with those cultivated from the throat. Whether this is entirely a specific effect or a mere variation in ordinary virulence remains to be proved.

4. In almost every experiment in which any difference could be noted the animal which received the protein injection showed the least corneal reaction to the infecting micro organism. No important difference however between the effect of antiphthenteric serum, concentrated horse serum and typhoid vaccine upon the infection could be observed in any of the experiments. Sterile milk although tried in only two experiments (1 and 2) that is 12 rabbits showed no effect whatever and the corneal lesions were similar in every way to those of the control animals.

From the clinical point of view may I conclude that I do not wish to be regarded as overenthusiastic about this subject but I feel bold enough to challenge you to administer antiphthenteric serum in your next 5 cases of penetrating wound with infection or of hypopyon keratitis before the infection has become overwhelming and then draw your own conclusions.

Furthermore I wish to affirm that colloid chemistry in medicine has come to stay and the sooner systematic and serious research of the varieties and forms of protein (animal, vegetable and bacterial) and their particular reactions to infection is made the more valuable will become our therapeutic strength to combat disease.

On the other hand I wish to state with some seriousness that we should not draw con-

clusions about protein effects too quickly, but rather we should sift the data and take stock as it were from time to time as to what has been shown to be reasonably true about it. We cannot accept much that we hear and read for protein therapy is too popular today to be all that is claimed for it. It is not a cure all by any means. In such instances the credulity of the laity, and even the profession is at stake.

#### DISCUSSION

DR ALAN C. WOOD: Dr Key's method of producing corneal lesions in animals with the minimal bacterial stimulus is I think quite important. It should be remembered however that the resistance of the individual animal to the bacteria is a factor which can definitely enter into the healing of the inflammatory lesion and is a factor almost beyond our control. Such variations in the resistance of individual animals to a specific bacterial insult will of course cause definite variations in the healing processes which would follow the injection of a definite amount of non specific protein and this factor should be very definitely considered when the results as to the comparative value of the different non specific proteins which may be employed is considered.

Many years ago the Indian Plague Commission observed that anti plague inoculations had a beneficial effect on miscellaneous infections and drew attention to the therapeutic rôle that non specific protein might play. It was finally realized that any substance which would produce a general shock reaction often produced a therapeutic change. This reaction to non specific protein has been the subject of a great amount of study. This reaction is characterized by the chill which follows the injection of the non specific protein, by the febrile reaction with fever sometimes of 100-106 degrees falling to normal within 24 hours by the increase in the pulse rate by the nervous irritability, the increase in glandular activity, nitrogen metabolism and permeability of the blood vessels, later followed by a decrease in the permeability and an increase in resistance to poisons by increase of lymph flow by lymphocytosis chiefly of the polymorphonuclears and more rarely of the eosinophiles and the mobilization of the proteolytic enzymes and lipases with a decrease in the anti ferment content of the serum occasionally by the mobilization of specific antibodies and lastly the occurrence of a definite focal reaction around the focus of inflammation.

The inflammatory focal reaction is of special interest to us as ophthalmologists. It has been shown that every inflammatory focus will give a focal reaction after injection of a non specific protein. Schmidt has shown that a localized inflammatory process non tuberculous in type will react to an injection of tuberculin and other non specific agents, nucleo-

proteins, nucleins, etc. Wolff Eisner has recently stated that he believes this is due to a sensitivity against protein in general which is produced by a localized inflammatory focus. This focal reaction is definitely diphasic in character, characterized in the primary phase by an increase in the inflammation in the secondary phase by a decrease in the inflammation and healing.

Numerous theories have been advanced by different observers to explain the beneficial results which can follow non specific protein therapy. Weichardt has supposed it to be due to a plasma activation resulting in a stimulation of the cell metabolism with a production of substances antibacterial in nature and a detoxication. Paltauf and Lowrey sought to explain the benefit of the non specific protein therapy on the grounds of stimulation of the heat regulatory mechanism. Heikroen, Ludke, Bull and others have shown that following non specific protein therapy there frequently results the mobilization of the antibodies specific for the primary infecting agent and they believe that non specific protein therapy may owe its beneficial effects to the fact that certain exciting agents are imperfect antigens containing the stimulus necessary for the production of antibodies by the cells but not the exfoliative stimulus necessary to cause the cells to throw off these protective antibodies into the blood stream. Such exfoliative stimulus they believe was supplied by the non specific agent Starckenstein who has done extensive experimental work on the eye following the injection of non specific protein believes that the beneficial effects are due to the secondary phase of decreased permeability of the blood vessels with the resultant greater resistance to poisons. Jobling and Peterson have brought much evidence to show that the mobilization of the proteolytic enzymes is the most important factor in the controlling of local inflammation by non specific protein therapy believing in short that these proteolytic enzymes act as detoxicating agents by degradation of toxic split proteins to non toxic amino-acid forms or by splitting up the protein to which the cells have become sensitized thus rendering it non toxic. More recently as Dr Key has said the attempt to explain non specific protein therapy on the basis of chemistry of colloids has been emphasized.

Further study of the non specific protein reaction has shown that there are an enormous number of substances which are capable in a greater or lesser degree of provoking the typical non specific reaction. Among such substances are the counter irritants, the normal and immune sera, antitoxins, proteins, egg albumin, milk, milk derivatives such as Dr Key has noted gelatin, nucleo-proteins, nucleohexyl, protein split products, enzymes, tissue extracts, vaccines without number, bacterial extracts, colloidal metals, yeast, etc.

Observers who have studied the non specific protein reactions most carefully believe there are very definite contra indications to its use and



leeway in the choice of the protein used. They have emphasized that the reaction is essentially diphasic, the first phase being characterized by the rather violent general symptoms and by the increase in the local inflammation, and the second phase characterized by the definite beneficial effects and the resolution of the inflammatory process as has already been emphasized. Therefore no patient should be submitted to this reaction unless the patient is a good clinical risk, well able to stand the augmentation of disease incident to the first phase. Further, inasmuch as when all is said and done the effects of non specific protein therapy are in the main dependent upon the stimulation of the cells, such non specific protein therapy should be used while the cells are still definitely capable of stimulation, and it must of necessity be of less value when the cells affected are exhausted by long drawn out disease. The question of dosage should be most carefully watched for deaths from excess dosages have been reported by Eggerton Krause and Mazza Borral and other observers also Wischardt has shown that while small doses stimulate the cells larger doses depress the cells. In the event that serums are used the question of hypersensitivity to such serums should be carefully determined before the serum is injected into the patient. If the hypersensitivity is present which can safely be determined by a preliminary skin test the patient should be desensitized before the serum is administered. In the case of vaccines, proteoses and milk the question of hypersensitivity is unimportant but in the case of serums there is a definite danger which should be guarded against. Diabetes, pregnancy and alcoholism are also said to be contra indications of the use of non specific therapy.

In the American clinics we find three proteins commonly used in the non specific protein reactions. The first of these is milk or some of its derivatives. This is certainly the mildest. The reaction which it produces is probably the most variable, as are like wise the therapeutic responses elicited. Antidiphtheritic serum is the second protein commonly used but it has been remarked that the non specific reaction elicited by the concentrated serum at present used is not so sharp as that elicited by the original unconcentrated serum. The third protein commonly used is typhoid vaccine which may be used either subcutaneously or intravenously. With this serum the dosage can be much more exactly controlled the response elicited can be prophesied with much greater accuracy and therapeutic results obtained have been at least equal to those observed following other forms of non specific protein therapy. Our choice of proteins in any case should not be limited to one protein. Nor should the non specific protein reactions ever be used as a routine in any given type of case. While it is indeed one of the most valuable therapeutic weapons we have it is nevertheless specialized therapy. The age and condition of the patient and the duration of the disease should be carefully considered before any specific protein is

chosen. In the case of a debilitated patient or when a mild reaction is desired, milk seems to me to be the protein of choice. In the event a more certain reaction is desired, antidiphtheritic serum may well be used after preliminary tests are made to determine the question of hypersensitivity.

If the local disease is advanced to any degree a much sharper stimulus will probably be needed to activate an organism or cell fatigued by disease. If the patient is a good clinical risk, intravenous killed bacilli may be used. But in non specific protein therapy which should always be considered specialized and never routine therapy, no hard and fast rule should be laid down. Our choice of protein and dosage should be governed by the reaction we desire to produce and this should be controlled by the condition of the inflammatory lesion and the general condition of the patient.

**Dr. G. GRAM RING.** During an operation for cataract on a man 82 years of age the cataractous lens became completely dislocated into the vitreous. No further effort was made by the operating surgeon to remove it. A stroke of apoplexy 6 years before bespoke a definite cardio-renal history. The eye was in a condition of chronic iridocyclitis with secondary rise of tension and was nearly sightless. Constitutional and local medication relieved the pain but lachrymation, redness and tenderness remained and 3 months later enucleation was done under general anesthesia. Ten minutes after being returned to his room the patient stopped breathing but respiration was ultimately re-established. After preliminary iridectomy the right eye was extracted April 1924 under local anesthesia to eye and lids. The following day the wound was healed, the anterior chamber reformed and the eye doing well. It so continued until the end of the fourth day. Violent endogenous infection next threatened the loss of the eye. A standard preparation of diphtheria antitoxin was employed together with the subconjunctival use of cyanide of mercury 1:3000.

In the cases previously reported the protein therapy was regarded as having been the active agent responsible for the improvement since no cyanide was used. The protein in the cases I am reporting was used in the first case 48 hours in advance of the cyanide and in the second approximately 4 hours previously. Improvement began prior to the use of the cyanide but was accentuated following the subconjunctival injections.

Ten cubic centimeters of the standard antitoxin solution was given in three doses with a total of approximately 1,650 milligrams of protein. The protein was administered at intervals of 48 hours, the cyanide closely following the last two injections.

The return of the normal tint to the iris was associated with the clearing of the cornea and anterior chamber and the absorption of the pupillary exudate. A flattened membrane remained above to which the iris was attached. The eye was quiet and perception and projection were normal. Two infected teeth proved to be the source of toxemia and were

removed. The infecting agent was the usual streptococcus viridans. In September 1924 an incapsulotomy resulted in vision of 20/50 plus.

In the case of Mr. B. I performed an uneventful preliminary iridectomy which was followed a few weeks later by the extraction of a so-called black cataract. The wound healing promptly with a resulting vision of 6/6. The eye continues in perfect condition. About 6 months ago a preliminary iridectomy was done on the fellow eye. Followed about a month later by the extraction of a black cataract. Rather more than the usual pressure was required to complete the extrusion, but no vitreous was lost and the eye was left in what seemed to be a satisfactory condition with the edges of the coloboma in normal condition and the pupil black. Considerable transparent posterior cortex evidenced itself the next day by an astonishingly extensive amount of cortical swelling which marked the beginning of a lens toxæmia. The eye ultimately became comparatively quiet with good perception and projection and a rather dense membrane above to which the iris was attached. This was so dense for a time that I feared it would have to be incised with a De Wecker scissors. To the usual local treatment was added the antitoxin with the final addition of two intravenous applications of arsenphenamin.

Despite all the attention the eye had received at the end of 5 months it still had a slight recurring flush. Five weeks ago under strict precautions a V shaped incapsulotomy was performed. The following day the eye had the appearance of a low grade infectious uveitis with no improvement in vision despite a satisfactory opening in the iris. We gave 4 doses of the antitoxin the volume equaling in protein content that outlined combined with an equal amount of cyanide of mercury subconjunctival injections 1:4000. A vision of 15/30 is the result.

The teeth should be X-rayed in all cases. It seems to me important that we record with as much exactness as possible the protein content of our solutions. I am advised by an expert associated with one of our leading laboratories that the total solids in the antitoxin solutions vary from 14 to 20 per cent. Taking 18 per cent as an average and deducting approximately 1 per cent for salts 17 per cent would represent the average solids in one cubic centimeter. Converting the cubic centimeter into grams and multiplying by the percentage of solids we arrive at the total protein content.

DR L. WEBSTER FOX. As to milk injections conclusions from a digest of the literature should be considered first. It would seem that there was considerable conflict in the reports from the countless workers and observers in this field and one would be led to believe that many of the reports were prejudiced from the very start either in favor of or against this form of therapy. The great weakness of the reports of an unfavorable nature is the very few cases cited by the observers making these reports. On the other hand those investigators who have had sufficient encouragement to continue the

treatment in a series of a thousand cases for instance must have had much greater benefit from their endeavors than their reports would indicate otherwise they would not have wasted valuable time in order to prove a worthless or dangerous procedure to have some value. We are greatly impressed by the uniformity in the reports of the Spanish and Spanish American workers from widely scattered sections. They are all favorable. On the other hand the Germans whose access to a good milk supply is not at all easy give an array of complications that would frighten any clinician and naturally they resort to laboratory refinements to produce something just as good. The treatment relieves pain, prevents infection and does considerable good in purulent affections of the anterior segment of the eye.

*Conclusions from our own experience.* Our attention having been first brought to the matter by personal communication from two most reliable workers namely Van Lint and Fernandez we tried the treatment in the beginning as a prophylactic against postoperative and posttraumatic infection with most encouraging results and then gradually began to employ it routinely in all cases in order to give it a fair trial. In this large experience we neglected to tabulate the cases so that we could present the data without fear of criticism. Our last 80 cases however have proved to us several things. First the fever and leucocytosis are essential to the production of benefit. If there is neither there will be no benefit. Often there is little or no fever but an increase in the leucocytes. In these cases there is scarcely any noticeable change in the condition for which the injections are given. In those cases in which the factor of bacterial contamination has been taken into consideration by preliminary examination of the milk we find several little surprises. First there is very little difference in the reaction between pasteurized milk, certified milk and powdered milk (this being dissolved in sterile water immediately before injection). Such differences are not greater than those which might occur between two different examiners or on different days. It is also interesting to note that several specimens of certified milk showed a higher bacterial count than the ordinary commercial pasteurized milk, a fact that would be of value to pediatricians and call for greater vigilance in the issuing of such certificates. All patients were somewhat improved. In none was the condition made worse or was the patient made to undergo any unnecessary illness as the result of the reaction. The ocular conditions most benefited were corneal ulcer, purulent ophthalmia and other purulent conditions affecting the anterior segment. Infection seemed to be prevented in traumatic and surgical case. Pain was relieved in many instances. We regard the treatment as safe and a valuable adjunct to our therapeutics but not necessarily important enough to replace other older and well tried measures. As compared to other forms of so called protein therapy we regard it as superior.

# PELVIC HERNIA

## REPORT OF A CASE OF POSTERIOR VAGINAL HERNIA<sup>1</sup>

By IITF MONROE MILES B.S. M.D. PEKING CHINA

Associate Obstetrician, 1 Gy. logy

**H**ERNIÆ occurring at the outlet of the pelvis have usually been classified into groups according to their point of appearance at the body surface. Thus they have been called pudendal, perineal or vaginal. It would seem advisable as in the case of other herniæ to have one term which would include all those herniæ originating in a given region. For the herniæ into the inguinal canal we use the one term, inguinal, and describe the variety by an added term, 'direct' or 'indirect' while herniæ through the anterior abdominal wall with the exception of those at the umbilicus are called ventral herniæ.

Chase (3) believes that the term 'levator hernia' as suggested by Blake is the most appropriate since it indicates the point of origin of these herniæ. While this term is most fitting for the pudendal and perineal varieties of these herniæ it does not apply to those forms which occur in the midline anterior and posterior to the uterus because at these two sites hernia do not traverse the levator muscles or fascia but pass between the muscles.

For this reason the writer proposes the term pelvic hernia as being an inclusive term describing all hernia through the pelvic floor and the point of egress of the hernia added gives the subvariety of the hernia the same as in the inguinal herniæ. The recognition and use of this term would group these rare herniæ together under one main head for purposes of indexing histories and medical literature. It would also be consistent with the best usage in nomenclature of herniæ bringing these cases into harmony with the terminology of herniæ in general which are named according to the point of origin and not of termination.

Herniæ through the pelvic floor are of rare occurrence. Moschcowitz (9) has reviewed the literature on the perineal variety of pelvic

herniæ and accepted from the numerous previously reported cases as genuine 25 cases and added 1 of his own making in all 25 cases of the perineal variety.

Chase (3) reviewed the literature of the pudendal variety of pelvic herniæ and found 12 cases previously reported and added 1 of his own making a total number of 13.

As has been frequently pointed out there are two possible points at which a hernia protruding into the vagina may originate, that is, posterior to the uterus in the cul-de-sac and anterior to the uterus between the bladder and the uterus. A hernia may also originate lateral to the uterus either anterior or posterior to the broad ligament and appear in the vagina covered by a complete sac of vaginal mucosa. This has been described twice by Thomas (12) and by Etheridge (4). These cases will be taken up later.

In reviewing the literature on vaginal hernia a greater degree of confusion of terms and description prevails than in either perineal hernia or pudendal hernia. Some authors have classified both cystocele and rectocele as vaginal herniæ while by far the greater number of cases reported on close analysis turn out to be cases of prolapsus or descensus of the uterus accompanied by a bulging of abdominal contents into a distended cul-de-sac. Several cases were of complete traumatic rupture of the vaginal wall and cul-de-sac with protrusion of uncovered intestines and 1 case was an operative rupture of the cul-de-sac with protrusion of viscera.

Cystocele and rectocele should be excluded from the classification as herniæ. One of the requisites of a hernia of the abdominal organs is the presence of a peritoneal sac which is entirely lacking in these two conditions. They are really prolapses of the anterior or posterior vaginal walls.

In descensus or prolapsus of the uterus accompanied by abdominal viscera bulging

into the cul de sac there is no true hernial sac and no ring or aperture through which the viscera herniate. The uterus descends because of stretched and attenuated cardinal and uterosacral ligaments the cul de sac is enlarged and there is really a descent of the floor of the pelvis. This condition is properly termed clytrocele or vaginal enterocele. It goes without saying that complete rupture whether traumatic or operative with exposure of the bowels is not a hernia.

Numerous case reports were found in the literature described as vaginal hernia but few of the writers gave a clear description of the relations of the parts and the location of the hernial ring merely stating that a vaginal hernia was present. Such cases were not considered as proved vaginal hernia and were rejected. But three cases observed clinically without operation or autopsy are considered in this report although some of the cases rejected were probably genuine.

**CASE 1.** Taylor (11) Patient age 22 3 days post partum felt something give way within her that produced a sense of fullness in the upper vagina. Examination 10 months after the onset of the tumor was refused and the symptoms were ascribed to prolapse of the uterus. A pessary was advised but did no good. During a subsequent pregnancy 3 months later the mass increased in size. It could be reduced spontaneously. Following the second delivery the tumor mass increased in size and on examination there was found a tumor as large as a middle-sized oval pessary occupying the posterior commissure of the labia below their external surface. Tracing it up to the right sacro iliac symphysis or an intermediate point between that and the mesial line I discovered its surface to be smooth and continuous with the vaginal mucous membrane its bulk diminishing at the slightest touch.

The accurate description and careful observation indicate that this is a true pelvic hernia of the posterior vaginal variety. The hernial ring was very evidently mesial to the uterosacral ligament and the hernial canal followed the posterior vaginal wall and appeared as a mass in the midline in the posterior commissure.

**CASE 2.** Ethendie (4) The patient is 19 or 20 years of age and has 1 child 11 months old. When she was about 6 months pregnant she jumped the rope one day and after that she felt something come down through the vagina. She went to full term and had a normal delivery. Whenever she lifts or strains the enterocele comes down presses the vulva apart and comes out between the thighs. On examination I find quite a large opening in the roof of the vagina. The edges of the ring can be very well outlined with the finger and when the hernia is down in the

vagina the finger in the vagina is at once attracted by a pendant mass and by pressing it a little one can determine that it is filled with gas. The opening comes down to the left of the uterus anterior to the broad ligament and posterior and left of the bladder.

The fact that this hernia descended into the vagina and not lateral to the vaginal canal differentiates it from a pudendal hernia. There was also a definite hernial ring present. This case falls into the classification of pelvic hernia anterior vaginal variety.

**CASE 3.** Barker (1) The patient 32 years of age in her third pregnancy fell and shortly afterward discovered a mass protruding in the vagina. She had all the symptoms of strangulation of a loop of intestine and on examination a soft mass about the size and shape of a glove finger was found in the vagina with a definite ring in the vaginal vault posterior to the cervix and a little to the right of the midline the ring was about  $1\frac{1}{4}$  inches in diameter. The mass was easily reduced. This case was carefully studied as she was observed during eight successive attacks.

Only one case described as vaginal hernia has ever been reported at autopsy. The more regrettable then that the description is so meager as to leave us in doubt as to the exact location. This case was reported by Birchenall (2).

**CASE 4.** A woman 63 years of age died in 19 hours following an intra abdominal injury received while at play. Autopsy was permitted. The husband informed me that his late wife had long been the subject of what I inferred to be a vaginal hernia but as it had caused her no particular inconvenience she would not allow him to speak of it even to myself. The viscera of the abdominal cavity were all healthy except the ileum upon this there was a diffused bright scarlet patch in locating recent acute inflammatory action. Here on careful examination I detected a minute orifice. The hernia was indeed in the vagina but it slipped back readily before the point of the finger.

The size location and direction of the hernia are not stated. I quote this only to show the paucity of the literature on this subject.

The case previously referred to that of Thomas (12) is of especial interest because it is the first case of vaginal hernia operated upon because of the location of the hernial ring and the presence of a fibroid tumor which was evidently the cause of the hernia as in the case of perineal hernia reported by Moschcowitz (9).

**CASE 5.** The patient was a multipara 39 years of age. For 6 years there had been present a mass in the vagina which had increased in size until it protruded from the vagina and hung down to the middle of the thigh on the right side. It could be reduced but when in position caused severe pain in the bladder and rectum.

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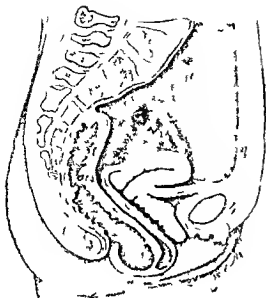


Fig 1 Sagittal sectional diagram showing condition found at operation

toneal fluid could be seen and felt in the narrowed isthmus between the two tumor masses.

On vaginal examination the cervix was found to be high in the pelvis and the uterus was anterior above the symphysis pubis an elastic mass was felt filling the lower abdomen. In the perineal region a large protruding mass was seen round smooth and covered by vaginal mucosa about 8 centimeters in diameter. A finger in the rectum detected the bulging anteriorly of the rectal wall into the tumor mass. No perineal body was present. Diagnosis was made of a large multilocular cyst of the ovary and rectocele. At operation on September 4, 1924, an ovarian cyst weighing with its contents 41 pounds was removed. There was much free peritoneal fluid and the intestines and peritoneum were covered with a gelatinous exudate. The uterus was small and high in the abdomen. The small intestines were not in the pelvic cavity and the mesentery was short and strong. The abdomen was closed in layers and the patient was in good condition. Unfortunately there was no suspicion in my mind at the time that the perineal mass was anything but a rectocele and the cul de sac was not explored. The patient's condition did not seem to warrant at that time the additional time under anesthetic required for a perineoplasty.

Recovery was prompt and uneventful. Pathological diagnosis of the cyst was multilocular cystadenoma of the ovary. Before discharge from the hospital the patient requested me to operate on the rectocele.

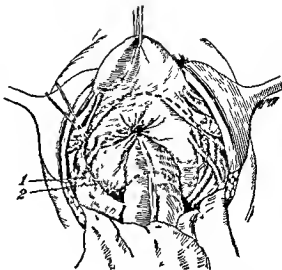


Fig 2 Closure of cul-de sac for pelvic hernia after Moschcowitz

Operation September 30, 1924. With the patient in the lithotomy position a curved incision was made across the perineum along the mucocutaneous border. The vaginal mucosa was dissected upward from the protruding rectum for a distance of about 2 centimeters when a clear thin walled sac was encountered which contained fluid. This sac was carefully dissected free from the rectum and vaginal walls. It was 5 centimeters in width at the lowest point and gradually became narrower in the upper vagina. The vaginal mucosa was dissected up to the level of the cervix. The sac was freed to this point and after it was determined that it contained nothing but fluid the neck of the sac which was about 2 centimeters broad was transfixed and ligated with chromic gut. The opening of the hernia sac was in the midline at the most dependent point of the cul de sac. The space was obliterated by suturing the anterior rectal wall to the vaginal wall and the levator muscles were interposed and the perineoplasty was completed in the usual manner.

Union occurred by primary intention and the patient left the hospital in good condition. She lives in a village at a distance from Peking and cannot be traced.

CASE 11. Feng Wang Shih hospital No. 11781. A Chinese woman 36 years of age. Vagina was admitted to the hospital on September 18, 1925 with the complaint of great abdominal distention of 2 years duration and general edema of the lower extremities cough for 2 months and a mass protruding from the vagina. Menstrual cycle has always been irregular the interval being 20 to 30 days and since November 1924 there has been complete amenorrhea. Family history and past history were of no importance.

Physical examination showed a fairly well developed well nourished Chinese woman sitting up

On examination the pelvic organs were in normal position and the bladder was in normal position in the pelvis. The hernia originated in the right vaginal fornix through an opening anterior to the broad ligament. It was proposed to perform a laparotomy and with the hernia held in reduced position by an assistant's hand in the vagina to suture the sac into the incision in the abdominal wall. This was carried out and it was discovered that there was an extraperitoneal mass of fibrous tissue attached to the apex of the hernia sac which was removed by incising the peritoneum of the sac and the operation was completed by suturing the sac into the abdominal wound. The patient made a good recovery.

#### Four cases of hernia occurring in the midline posteriorly and separating the rectum and vagina have been reported at operation

**CASE 6** Hugnier (6) The patient 46 years of age was operated upon November 18, 1911 for prolapse of the uterus vaginal prolapse and hypertrophy of cervix. First operation: Curettage amputation of cervix anterior colporrhaphy perineorrhaphy and abdominal hysteropexy Dolens operation.

In May, 1912 the patient returned stating that the condition had recurred. At examination a soft tumor about half the size of a mandarin orange was found in the midline posterior to the vagina bulging into the vulva. Rectocele was the diagnosis made. At operation a hernial sac was found in the midline of the vaginal wall separating the vagina and rectum. This was dissected upward for 8 centimeters and was opened ligated and excised. Operation was completed by suture in the midline of the levator muscles at several levels.

**CASE 7** Lothrop (7) The patient 41 years of age multipara suffering from lacerations at childbirth in July 1903 was operated upon for rectocele cystocele and abdominal fixation of uterus for prolapse. In December 1908 she was operated upon again for rectocele. Again there was a recurrence of protrusion from the vagina. In 1909 she was delivered of a child following which the mass increased in size. She was seen by Dr. Lothrop in September 1912. At examination a mass the size of a fist was discovered protruding from the posterior wall of the vagina in the midline. It was easily replaced by appearing on lying down. It was not a rectocele as a finger in the rectum did not enter the tumor.

Operation was carried out by the abdominal route. The uterus was not prolapsed but was still attached to the anterior abdominal wall. The neck of the sac was in the midline at the bottom of the cul-de-sac the sac contained coils of small intestine. The broad ligaments were divided close to the uterus and the uterus was split in half and the anterior half including the uterine cavity was removed. The sac was then dissected out and the broad ligaments were turned down and sutured across the defect in the pelvic floor. The part of the uterus remaining was also sutured to the pelvic fascia at either side of the rectum and the peritoneum was closed over both broad ligaments and the uterus.

She was seen 3 months after operation and there was no recurrence.

**CASE 8** Hartmann (5) The patient 30 years of age was delivered of her first child at 22 years of age a perineal laceration was repaired later. She was again delivered at the age of 24 and suffered from prolapse of the uterus which was corrected by an abdominal fixation of the uterus. Two years later a perineorrhaphy was performed. She was again delivered at term at 29 years of age. Follow-

ing the confinement the prolapse reappeared with identical appearance as before the hysteropexy only larger. She was seen by Hartmann in 1910 who described the condition as a large smooth round mass protruding from the vagina in the midline posteriorly. The tumor could be reduced by taxis with a gurgling sound. The perineum was thick and strong. There was no rectocele. The uterus was not prolapsed.

At operation in June 1911 the hernia sac was dissected upward from the vaginal route separated from the rectum and vagina and excised above the level of the cervix. Coils of small intestine were found in the sac. The cul-de-sac was closed with sutures and the rectal and vaginal walls sutured together obliterating the hernial space. The perineum was reinforced.

The patient was again confined in April 1913 more than 2 years after operation and there was no recurrence of the hernia.

**CASE 9** Sweetser (10) The patient age 37 years single had never been pregnant. The past history was negative except for salpingectomy and appendectomy apparently for pyosalpinx and later typhoid fever. Her present trouble dated from the attack of fever in 1914 when she noticed a swelling in the midline of the vagina posteriorly. This increased in size as she resumed her work. The tumor interfered with her work though she experienced no sharp pain. The tumor would also disappear in the recumbent position. The vaginal orifice was much relaxed and on straining the posterior wall bulged forward producing a tumor the size of a small orange which was easily reducible. The uterus was in normal position. The perineum was intact and the rectum did not take part in the tumor.

Operation perineal route. The hernia was dissected up to the level of the cul-de-sac and then the abdomen was opened and the hernia ring was closed from above. No bowel coils were in the sac which contained fluid. The abdomen was closed and again through the perineal incision on the sac was ligated and excised and the levator muscles were sutured over the stump. Convalescence was uneventful but efforts to trace the patient were not successful.

#### AUTHOR'S CASES

**CASE 10** Pu Chung Shih a Chinese woman 46 years of age was admitted to the Peking Union Medical College Hospital on September 3, 1924. Her complaint was great swelling of the abdomen which had begun 2 years prior to admission and had increased in size until she was greatly distressed. Her past history was negative. She had given birth to 3 full term children the last 19 years ago. She had been frequently needled by native Chinese doctors during the course of her disease.

Physical examination revealed a very emaciated woman with a greatly distended abdomen. The circumference of the abdomen at the umbilicus was 116 centimeters and from the xiphoid cartilage to the symphysis measured 62 centimeters. The abdomen presented to palpation a smooth tumor mass with a marked enlargement in the upper abdomen and another in the lower abdomen with a distinct depression above the level of the umbilicus. Percussion note was flat all over the abdomen. A distinct fluid wave could be detected on tapping the abdominal wall and with the flat hand making sudden pressure in the flanks a wave of free per-

The muscles forming the levator ani group are interrupted in their perfect closure of the pelvic outlet by the rectum the vagina and the urethra. That hernia do not more often occur in the midline between these tubular structures is very remarkable. The fusion between the rectum and vagina is not dense and their more frequent separation by the stretching of the peritoneum of the cul de sac would be expected. That it does not occur is probably due to three factors: the sigmoid colon is a thick walled tube and because of its length is coiled over the weak spot in the bottom of the cul de sac supported by the uterosacral ligaments; the mesentery of the small bowels gives enough support to prevent undue pressure of these organs in the cul de sac; the normal inclination of the pelvis throws the weight of the abdominal contents on the anterior abdominal wall and the bony structures forming the anterior part of the pelvis.

#### ETIOLOGY

There is of course the same possibility that in common with other herniæ these herniæ may be either congenital or acquired. Failure of fusion between the rectum and vagina might occur leaving a weak spot into which the peritoneum of the cul de sac might be stretched under conditions of abdominal pressure or there might even be a congenital peritoneum lined space between the rectum and vagina. More probably, trauma is the direct etiological factor as all the patients reported but one were parous and had undergone the strain of pregnancy and labors. Repeated labor undoubtedly loosens the connective tissue attachments of the uterus and vagina. This together with abdominal or intra abdominal conditions such as ptosis of the viscera or increased intra abdominal pressure due to tumors or accumulations of fluid causes the deepening of the cul de sac and a hernia to develop.

Hernia between the rectum and vagina usually develop gradually. Of the cases studied only 2 appeared suddenly and there were signs of strangulation in only 1. Of the anterior vaginal herniæ 1 appeared suddenly and 1 gradually and neither showed signs of strangulation of hernial contents.

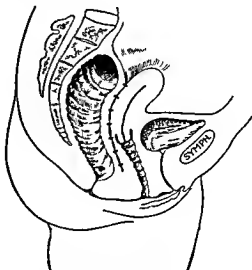


Fig 3 Closure of cul-de sac for pelvic hernia completed (After Moschowitz)

#### SYMPTOMS

Since the usual course of development is gradual the symptoms are mild. Incapacitation for work is caused by the inconvenience of the protruding mass and not as a rule on account of pain. Bladder and bowel disturbance may be noted. Symptoms are more marked in the anterior variety than in the posterior. Only 1 case (Barker) of the posterior variety showed signs of strangulation.

#### DIAGNOSIS

Patients who come to the physician because a mass protrudes from the vagina are *a priori* considered to be suffering from rectocele and this constitutes the chief difficulty in diagnosis. Of the 6 patients operated upon the diagnosis of vaginal hernia was made before operation only twice (Sweetser Miles) and in 3 of those operated upon the diagnosis was not arrived at during the first operation though the prompt recurrence of the vaginal mass after operation would indicate that the hernia was present at the time of operation. Another difficulty arises from the fact that the internal ring is large and that these herniæ disappear in the recumbent or lithotomy position. This latter point is one of the most important in diagnosis that is the presence of a mass in the



in bed with considerable embarrassment of respiration. The heart was normal, the lungs were evidently displaced upward as the hyperdulness was considerably higher than normal auscultation revealed no rales throughout the chest.

The abdomen was greatly distended and was tense. Fluid wave was elicited throughout the abdomen and to percussion the abdomen was dull throughout. No intra abdominal tumors or masses could be palpated. The circumference of the abdomen at the level of the umbilicus was 134 centimeters.

On vaginal examination we found protruding from the vagina posteriorly in the midline a pinkish soft fluctuant mass about 5 centimeters in diameter and 7 centimeters in length. Pressure on this mass caused reduction in its size with no gurgling sound. The outlet was parous but not relaxed. Rectal examination showed no rectocele. The cervix was high and the fundus of the uterus could not be definitely palpated. No pelvic or abdominal masses were felt. Movement of the cervix and the uterus with the fingers in the posterior vaginal vault gave the sensation of moving a body through fluid.

The lower extremities were very edematous.

The patient denied having been needled by Chinese doctors but on the abdominal wall there were three shallow ulcers to the left of the midline below the umbilicus which would appear to negate her denial.

A tentative diagnosis was made of vaginal hernia, ascites, and probably some tumor of the ovaries as a cause of the amenorrhea and ascites.

Paracentesis of the abdomen was done on the evening of admission and 25 liters of ascitic fluid were removed. After removal of this fluid a large irregular nodular tumor could be palpated in the abdomen. This tumor extended from the pelvis to the costal margin was more prominent on the left side and was fairly freely movable but at the same time seemed to have attachments in the upper abdomen.

Following paracentesis the edema of the legs disappeared in 12 hours the vaginal hernia disappeared and the lung condition cleared up.

Our final pre-operative diagnosis was vaginal hernia, multilocular cyst of ovary with the possibility because of the ascites that the tumor might be a fibroma instead of a cyst.

Operation was performed on September 29 by Dr. J. P. Maxwell, Dr. Miles assisting. The tumor was found to be a large multilocular cystadenoma of the left ovary with a twisted pedicle and numerous vascular attachments to the omentum. It was removed without great difficulty.

The pelvic condition was then explored. The cul-de-sac was found to be greatly enlarged, the uterosacral ligaments were stretched and the cul-de-sac was much broader than normal and also deeper, a pouch the size of a large orange being formed below the uterosacral ligaments. The uterus had not descended but was higher than normal.

In the bottom of this enlarged pouch there was an opening that would admit a finger only extending downward between the rectum and the posterior vaginal wall. This sac when distended with ascitic fluid must have been the protruding mass noticed at first examination. The writer then closed this hernial sac and the enlarged cul-de-sac after the manner described by Moschowitz (8) by insertion from below upward of a series of purse string sutures of medium silk completely obliterating the cul-de-sac and uniting the anterior rectal wall to the posterior surface of the uterus up to the level of the internal os. This closure was not difficult.

The operation was completed by closing the abdomen in the routine manner. Convalescence was uneventful.

#### ANATOMICAL RELATIONS

From a study of these cases it will be seen that the hernia which appear in the vagina most frequently originate in the bottom of the cul-de-sac and the internal ring is formed by the two uterosacral ligaments and the anterior rectal wall. This occurred in 5 of the cases operated upon and apparently in 1 case not operated upon. In these cases the course of the hernia was directly in the midline separating the rectum and vagina and appearing in the vulva or protruding through it in the posterior commissure. The contents of the sac in 2 cases was fluid only in 2 cases contained loops of small bowel in 1 case contents of sac were not stated and the cases not operated upon also quite evidently contained bowel. Of the 5 cases operated upon two had no rectocele (Sweetser Miles) while in the others rectocele was evidently present as in 3 cases (Huguier, Lothrop and Hartmann) the patients had undergone operations for correction of rectocele and in the fourth (the author's case) rectocele was present and was demonstrated at operation. In one of the other operative cases (Thomas) the hernial ring was anterior to the broad ligament through the levator muscle but the hernia instead of descending lateral to the vagina and appearing in the vulva appeared in the vagina and the sacculated vaginal wall formed one of the covering coats of the hernia. This would appear to be the condition in the case of Etheridge though in this latter the protrusion appeared more nearly in the midline anteriorly and was not nearly so large.

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## THREE CASES OF THYROID METASTASIS TO BONES

WITH A DISCUSSION AS TO THE EXISTENCE OF THE SO CALLED 'BENIGN METASTASIZING GOITER'

BY WALTER M. SIMPSON, M.S., M.D., ANN ARBOR, MICHIGAN

Se 1 1 oct F th l gy U v v s ty M h g

THREE cases of osseous metastasis of thyroid tissue are herewith reported. At the time of admission to the University of Michigan Hospital the three patients presented a symptomatology which directed the clinicians' attention chiefly to the bone tumors. The first was a case in which spontaneous fracture of the femur occurred as a result of the presence of a tumor composed of histologically benign thyroid tissue. A small goiter gave no evidence of malignancy. In the second case the metastasis was to the astragalus. Again the microscopical picture was that of typical thyroid tissue and the patient possessed a small symmetrical goiter which was regarded as clinically benign. The third patient presented signs of vertebral neoplasm with compression myelitis but with no clinical signs which might direct suspicion to the thyroid gland. Laminectomy exposed a hazel nut sized tumor in the sixth cervical vertebra which on microscopical examination contained areas of typical thyroid tissue.

All these patients later developed unmistakable clinical evidence of malignancy of the thyroid gland and all died within a year and a half following operation. One case came to autopsy.

### BENIGN METASTASIZING GOITER

The bizarre character of primary and secondary neoplasms of the thyroid gland has long intrigued the interest of the pathologist and the surgeon. The alleged failure of

these new growths to conform to the generally accepted doctrines of neoplasia has led to widely divergent conceptions of their origin and manner of growth. The mysteries surrounding the physiology of the thyroid gland have been shared by its obscure pathology.

One outstanding incongruity concerns itself with the so called "benign metastasizing goiters." In almost every instance those who have reported these cases have been struck by the paradox of simple goiters and benign thyroid adenomata with multiple metastases. Such an assumption is at once in direct contradiction of one of the most firmly established doctrines concerned with the biology of malignant new growths. The development of multiple metastases has long been considered *prima facie* evidence of malignancy. The statement that metastases of thyroid tissue do not conform to this fundamental rule at once places a heavy burden of proof on those who suggest such a possibility. As recently as 1923 Joll (43) in the course of a Hunterian Lecture before the Royal College of Surgeons declared that the thyroid gland may be quite normal in every way, and the metastasis may have either the structure of normal thyroid tissue of an innocent thyroid tumor or of a tumor exhibiting any degree of malignancy. One purpose of this paper is to weigh the evidence as it appears in the literature for or against the existence of such an entity and to prove that there is no basis for the belief that thyroid gland tissue behaves

vagina or protruding from the vulva which disappears when the patient lies down, and reappears as the patient assumes the erect position or bears down with the abdominal muscles or coughs. Manual replacement of the mass if it contains coils of bowels, should be accompanied by a gurgling sound. If the sac contains fluid only, this sign will be absent.

Hernia must be differentiated from vaginal cysts. Inclusion cysts in the lower vagina present a characteristic appearance but cysts of the ampulla of Gartner's duct in the upper vagina might readily cause confusion. Cysts are without symptoms of strangulation and are generally irreducible though rarely a Gartner's duct cyst appearing in the vagina can be reduced on pressure the fluid returning along the duct to a cyst of the parovarium in the broad ligament. Vaginal cysts are usually lateral to the cervix.

Diagnosis will probably be made most frequently at operation and all large rectoceles should be suspected of being complicated by a hernia, and in all such cases the vaginal wall should be dissected high up and a search made for the hernia sac. Unless this is done a small proportion of cases will apparently recur the hernia will again protrude and the patient will be dissatisfied with the treatment.

#### TREATMENT

Of the 6 operative cases reported 3 were done entirely through the perineal route 2 by abdominal route only and 1 by combined perineal and abdominal routes. Only 1 case that of Hartmann done by the perineal route, has been followed up for a long period of time and apparently resulted in a cure. It would seem that the best results are to be obtained by a combination of abdominal and perineal operation. The sac should be dissected up to the level of the cervix and its contents reduced the neck of the sac ligated and the sac excised. The vaginal wound should be repaired in such a manner as to secure firm union between the rectum and vaginal wall and the perineum repaired. Then if possible the abdomen should be opened with the patient in the Trendelenburg position and the cul de sac should be obliterated according

to the technique devised by Moschcowitz (8) which consists in passing through the peritoneum and outer muscular coats of the rectum and vagina a series of purse string sutures of linen or silk and closing the cul de sac from below upward high on the cervix of the uterus. This was considered in my case but as the patient had just undergone an abdominal operation we hesitated to re open the abdomen and hoped to secure relief by a less radical operation.

Such a radical operation as was performed by Lothrop does not seem to be indicated at the present time.

#### SUMMARY

The literature on the subject of vaginal hernia has been studied and 9 cases which appeared to be definitely of this order have been reviewed with 2 additional cases by the author.

The cause of these herniae is with one exception found to be traumatic following pregnancy or childbearing.

A new classification embracing all herniae occurring through the pelvic floor is offered following the general usage of terminology and classifying it according to its course thus pelvic hernia may be perineal pudendal or vaginal and vaginal pelvic hernia may be (a) anterior or (b) posterior. Prolapse of the uterus accompanied by a general enlargement of the cul de sac and protrusion of abdominal contents into the vaginal vault should be called either elytrorcele or vaginal enterocoele and not a hernia.

The treatment is operative and the best operation is a perineal operation by which the sac is excised and the perineum is repaired combined with an abdominal operation for obliterating the cul de sac.

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WITH A DISCUSSION AS TO THE EXISTENCE OF THE SO CALLED BENIGN METASTASIZING GOITER. 1

BY WALTER M SIMPSON MS MD ANN ARBOR MICHIGAN  
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THREE cases of osseous metastasis of thyroid tissue are herewith reported. At the time of admission to the University of Michigan Hospital the three patients presented a symptomatology which directed the clinicians attention chiefly to the bone tumors. The first was a case in which spontaneous fracture of the femur occurred as a result of the presence of a tumor composed of histologically benign thyroid tissue. A small goiter gave no evidence of malignancy. In the second case the metastasis was to the astragalus. Again the microscopical picture was that of typical thyroid tissue and the patient possessed a small symmetrical goiter which was regarded as clinically benign. The third patient presented signs of vertebral neoplasm with compression myelitis but with no clinical signs which might direct suspicion to the thyroid gland. Laminectomy exposed a hazel nut sized tumor in the sixth cervical vertebra which on microscopical examination contained areas of typical thyroid tissue.

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Fig. 1 Low power view of vertebral metastasis showing large colloid-containing acini surrounded by simple low cuboidal epithelium immediately adjacent to area of papillary adenocarcinoma devoid of colloid.



Fig. 2 High power view of vertebral metastasis showing island of normal appearing colloid-containing acini covered by a single layer of flattened cells in the midst of an area of adenocarcinoma.

in a manner entirely different from that which characterizes all other human tissues.

The literature and textbooks have persistently referred to this extraordinary circumstance since 1876 when Cohnheim (7) first reported a case of this kind which he designated *Einfacher Gallertkropf mit Metastasen*.

A woman of 35 developed a painful swelling in the left knee and dull pains in the left sacro iliac region accompanied by a hectic temperature. Aspiration of the knee joint gave relief for 6 months after which the fever returned and a large left sacro iliac abscess appeared and was incised. The deepest portion of the abscess was continuous with the bone which was curetted. Rapid emaciation and death followed. Necropsy revealed many small pea sized grayish white to grayish red homogeneous translucent masses in the lungs with similar gelatinous honey like deposits in the walnut sized bronchial lymph nodes. The skeletal examination showed invasion of the second third and fourth lumbar vertebrae with a reddish raspberry jelly like mass. The bone marrow of the right femur contained a similar soft mass of hazelnut size. The femoral cortex had been eroded from within producing wide dilatation of the medullary canal. Both lobes of the thyroid gland were enlarged the left more so than the right. The right showed normal follicular structure. In the left lobe were two large nodules. The one showed a gelatinous structure identical with that of the masses in the lungs and bronchial nodes. There was no infiltration to neighboring structures. The smaller of the two gelatinous nodules had a small button like mass

which extended into a tributary of the inferior thyroid vein.

Microscopical examination of the gelatinous nodules in the thyroid gland and those of the bones and lung and bronchial nodes revealed the structure of simple colloid cysts. The curettings from the gluteal abscess likewise showed the typical histological structure of thyroid tissue.

Cohnheim said however that a few of the follicles were completely filled with epithelial nests. His conclusion was that the new growth in the thyroid was a simple colloid adenoma with multiple metastases. He rather slighted the significance of the direct growth into the vein by simply stating that it had been observed in many cases without metastasis. He attempted to explain the absence or presence of metastases in these cases of venous invasion by assuming that a special constitutional individuality made metastases possible in one instance and not in another.<sup>1</sup>

In this case we have three important evidences of malignancy: first multiple metastases; second tumor thrombosis of the inferior thyroid vein; and third proliferating cell nests in the thyroid acini. So it would appear as though this original paradoxical assumption of benign tumors with multiple metastases was based upon a false interpretation. Since this first questionable observation the literature has contained many analogous reports. That the writers of these subsequent similar papers were greatly influenced in their decisions by Cohnheim's interpretations as expressed in this original report is indicated



Fig 3 Photomicrograph showing metastatic papillary adenocarcinoma of thyroid origin in body of seventh cervical vertebra

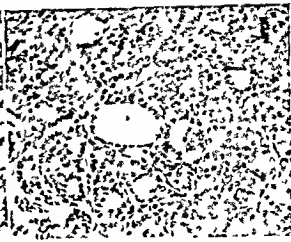


Fig 4 High power view of thyroid metastasis to femur showing well-defined colloid containing acini and smaller acini of the fetal type devoid of colloid

by their almost invariable reference to this first recorded case. A resume of many of these cases will be found at the end of this paper. A search of the literature reveals 77 cases of so called metastasizing goiter. Many of these cases were discovered in reports in which the title gave little hint of their content and it is quite probable that there are many other similar cases with their identity hidden by irrelevant titles.

Four years after Cohnheim's report Morris (55) told of a somewhat similar case in the Transactions of the Pathological Society of London (1886). The inadequate study of this case with no examination of the thyroid gland and a very limited autopsy leads only to the conviction that no accurate conclusions can be drawn from such cursory examination. Nevertheless this paper marked the beginning of a long series of similar English case reports.

#### ECTOPIC ANLAGEN THEORY

Honsell (36) made a spirited defense of Cohnheim's theories. He discussed at length the possibility that the metastases might represent displaced thyroid anlagen particularly as in his case the thyroid tissue in the frontal bone first appeared at puberty. This last factor has no significance because practically every other case reported occurred in late adult life. It is now quite firmly estab-

lished by careful embryological studies that even though aberrant thyroid tissue is a common developmental anomaly it is always found in the immediate neighborhood of its primitive origin the median derivative from the thyroglossal duct and the lateral paired derivatives from the ventral borders of the fourth pharyngeal pouches. Accessory thyroid masses may therefore be found anywhere from the foramen caecum of the tongue to the arch of the aorta in the median line as derivatives of the thyroglossal duct or lateral aberrant masses may be found as remnants of the branchial cleft derivatives usually about the middle of a line from the mid clavicle to the tip of the mastoid process. Adenomatous, cystic and carcinomatous degeneration of these detached islands of thyroid tissue is not at all uncommon. Rosenthal (78) found in the literature over 100 cases in which a tumor of the posterior one-third of the tongue proved to be thyroid gland. He emphasizes the frequency with which operative removal is followed by grave symptoms of myxedema and tetany (9 to 22 per cent) indicating that all of the thyroid tissue and possibly parathyroid also may have come to lie in the tongue. Tyler (79) and Ashhurst and White (80) have reported instances of primary carcinoma of lingual thyroid the former with extensive metastasis. Primary malignancy of lateral

aberrant thyroid tissue has been repeatedly reported (Schrager 81 Wohl 82, Pollard 83, Gerster 84 Greensfelder and Bettman, 85 Gutmann 86 Hinterstoisser 87 Kamsler 88 Parcelier, Venot and Bonnin, 89 Peyron Ranque and Senex 90, Schiller 91 Pool, 92, Berger 93)

But to this rule which limits quite sharply the regions in which thyroid tissue may be found as developmental arrests there is one exception. This concerns itself with the complex teratomata which may be encountered rarely in various parts of the body, but chiefly in the ovaries testes and sacral region. Six instances have been recorded in this laboratory in which trigeminal teratoid tumors (dermoid cysts) of the ovary have contained mature thyroid tissue along with the other mixed tissues that make up these complex tumors. In two of these the thyroid mass was as large as an orange. In most the structure was that of either a simple colloid goiter or an adenomatous colloid goiter. It is of interest to observe that thyroid tissue in ovarian teratomata of women of the Great Lakes region shows the same tendency toward goiter as that of the thyroid gland itself. One case in particular (Miss A. B. case 3026 AB) excites extraordinary interest because of the development of thyroid adenocarcinoma in such an ovarian teratoid inclusion. In this case in addition to the areas of adenocarcinoma there were small islands of medullary carcinoma with marked vacuolization of the epithelial cells. Kovács (94) has recently described a case in which a thyroid tissue tumor of the ovary was accompanied by the symptoms of exophthalmic goiter which subsided after removal of the tumor.

Any argument that seeks to prove that distant masses of thyroid tissue represent ectopic thyroid anlagen is rendered further invalid by the fact that in many of the reported cases of benign metastasizing goiter there were multiple widely scattered foci of thyroid tissue. The claim of some authors that aberrant thyroid tissue may be the source of thyroid new growths in the mandible sternum and clavicle is rendered untenable by the fact that in the 77 cases

herewith analyzed the skull was involved 30 times the vertebrae 25 times while the clavicle and sternum were each invaded 9 times and the mandible but twice. Further more the cases of clavicular and sternal metastases were almost invariably associated with multiple metastases involving other bones.

#### INADEQUATE STUDY OF REPORTED CASES

Perhaps the most convincing argument against the existence of the so called benign metastasizing struma is the fact that the great majority of reported cases were incompletely studied and hence do not justify positive assertions. In 29 cases only (38 per cent) of the 77 which I have gathered from the literature was tissue from the thyroid gland examined *microscopically*. In most of the remaining cases the histological study was woefully inadequate. Such cases demand the study of many sections. It is still customary in many laboratories to examine routinely but one or two sections. It is obvious that no conclusions should be drawn following such cursory study. Most authors have merely stated that the thyroid gland showed outwardly no signs of malignancy or that there was no recent accelerated growth. Such statements are of no value since a high proportion of cases of malignancy of the thyroid are discovered only after routine histopathological examination. A small pea sized primary malignant adenoma or area of adenocarcinoma hidden deeply in an innocent appearing thyroid gland can readily give rise to extensive osseous and visceral metastases. Von Eiselsberg (95) Woelfler (73) and Huguenin (37) have emphasized that the primary thyroid tumor may be so small that it is only with great alertness that it can be found while metastases may be massive. In Huguenin's case it was only after repeated searches that he discovered in the inferior pole of the left thyroid lobe a small whitish area 4 by 5 millimeters made up entirely of carcinoma cells.

And in only 33 per cent of the reported cases was autopsy done! It is even more interesting to note further that in many of those cases on which microscopic studies

have been made atypical cell forms 'sol-  
id round or filiform islands of epithelium  
characteristic of rapidly proliferating cells'  
'cells with numerous mitotic figures' "poly-  
morphism of cell cords are variously de-  
scribed. Such statements create considerable  
doubt as to the benignity of the cells so  
described.

In most cases the report was published  
shortly after the discovery of the benign  
microscopic appearance of the metastases.  
The writers were apparently satisfied with  
the knowledge that the thyroid gland showed  
no external evidence of malignancy and  
made little or no attempt to learn of the  
ultimate outcome. Such a course is unwise  
because of the extremely slow growth of  
most thyroid carcinomata and it is quite  
probable that if the ultimate cause of death  
could be determined in these cases they would  
show a high proportion of deaths from un-  
questionable carcinoma of the thyroid. The  
experience of Alamartine and Jaboulay (1a)  
is a case in point. In 1908 they told of a  
woman of twenty three years who had pos-  
sessed a tangerine sized goiter for two and  
one half years. An orange sized pulsatile  
tumor developed at the upper end of the  
humerus which was diagnosed aneurysmal  
sarcoma. On auscultation *bruit* was heard.  
During this time the goiter remained without  
modification of size or consistency. Resec-  
tion of the upper portion of the humerus was  
done and the microscopic examination of the  
tumor showed typical thyroid tissue. The  
thyroid gland was not examined microscopi-  
cally and on the strength of the clinical be-  
nignity of the thyroid tumor and the innocent  
microscopical appearance of the metastatic  
tumor it was thought to be a case of benign  
metastasizing pnter.

In 1911 Alamartine and Bonnet (1b) ren-  
dered a further report on the same case and  
told of the later development of multiple  
metastases in the right femur (with spon-  
taneous fracture) and to the vertebrae fol-  
lowed by death.

Further proof of this tendency to report  
such cases prematurely is to be found in the  
first and second reports of a case by Oderfeld  
and Steinhaus (58). In 1901, under the

title "*Zur Casuistik der Knochenmetastasen  
von normalem Schilddruesengewebe*" they told  
of a woman of 58 with an egg sized elastic  
tumor replacing the left frontal bone. It had  
attained this size in 3 months. It was diag-  
nosed as sarcoma and extirpated. The tumor  
was exceedingly vascular and extended to the  
dura mater. The convalescence was un-  
eventful and when the patient was seen a  
half year later there was no recurrence and  
she was in excellent health. Microscopically  
the tumor was made up of normal appearing  
thyroid tissue. There were no enlargement of  
the thyroid gland and no palpable accessory  
thyroids.

In 1903 the second report (58) appeared.  
The situation had changed remarkably. Six  
months following the last examination men-  
tioned in the previous paper the patient was  
markedly emaciated and showed a chicken  
egg sized recurrence in the left frontal bone.  
The right thyroid lobe had undergone con-  
siderable enlargement simultaneously there  
appeared a tumor in the right temporal bone  
which grew to the size of an apple. A walnut  
sized tumor was found at the right sterno-  
clavicular articulation. Death followed the  
surgical removal of the temporal metastasis.  
Complete autopsy was not permitted but  
the upper sternum, clavicle, trachea and  
thyroid and the frontal recurrence were  
removed postmortem. The sternoclavicular  
nodule and recurrence showed the same mi-  
croscopical picture as previously—normal  
thyroid tissue. An encapsulated spherical  
nodule in the right thyroid lobe was recog-  
nized as the primary tumor.

Much stress has been laid upon the micro-  
scopic appearance of the secondary deposits.  
In a large measure the tendency to consider  
this whole group as benign has arisen from  
the fact that the metastases frequently  
look much like normal thyroid tissue or that  
they simulate benign thyroid adenomata.  
There is abundant evidence to indicate that  
a metastatic area of thyroid adenocarcinoma  
may indeed assume the appearance of typical  
thyroid tissue. Fwing (96) says. The nat-  
ural tendency of the metastatic thyroid cells  
to develop into normal thyroid tissue may  
progressively alter the structure of a secondary



growth so that an original carcinomatous area may eventually appear adenomatous

The fact that carcinomatous metastases may possess identical morphological characteristics as normal thyroid tissue is illustrated quite clearly by the first of our 3 cases a description of which appears later in this paper

Crone (9) studied 6 cases of supposed benign metastasizing struma and in 3 of these tissue from the thyroid gland was later examined and undoubted evidence of primary thyroid carcinoma was found in each even though there was no clinical evidence of thyroid malignancy

In the abstracts of previously reported cases which concludes this paper will be found 5 cases (indicated by asterisk) in which the metastases showed the histological architecture of normal thyroid tissue while microscopic study of tissue from the thyroid gland revealed areas of primary carcinoma

Even though this tendency closely to mimic the mother tissue in cell structure and in colloid elaboration is highly developed in the metastases of thyroid new growths there are other tumor types which continue to perform in a more or less perverted manner their normal function The enamel formation by adamantinocarcinoma mucin formation by carcinoma arising in the bronchi or in the large bowel melanin formation in the metastases of melanoblastoma and keratin hyalin production by squamous cell carcinoma constitute common examples

In addition to the marked morphological similarity between normal thyroid tissue and that found in these distant masses there is proof of their ability to elaborate vicariously the specific internal secretion of normal thyroid cells Von Eiselsberg (97) tells of a case in which total thyroidectomy for carcinoma was done by Billroth on a woman of 38 followed by typical signs of myxedema and tetany These persisted for years and then gradually regressed and ultimately disappeared as a nodule developed in the sternum The sternal nodule gradually increased in size for 2 years and showed marked increase in size during menstruation and regression following menstruation Finally it grew very

rapidly causing excruciating radiating pains and 4 years after its appearance was extirpated Grave signs of hypothyroidism developed following the operation and persisted Microscopic examination showed colloid containing metastasis of a thyroid adenocarcinoma Ewald (98) and Gierke (21) have demonstrated iodine in such metastases

#### DETACHED NORMAL CELL THEORY

Much has been said concerning the extraordinary vascularity of the thyroid gland and the intimate relationship existing between the normal thyroid cells and the blood spaces Even the existence of an interposed basement membrane has been denied (von Eiselsberg) The defendants of the benign metastasizing goiter theory claim that it is mechanically possible for normal thyroid cells to become detached and carried by the blood to distant structures and there set up independent growth ultimately assuming normal thyroid structure and function The reason for this extraordinary growth energy of normal thyroid cells has never been suggested It certainly leaves the burden of proof with the metastasizing goiter adherents If normal thyroid cells possess this power to proliferate in a congenial environment and it would appear as though cancellous bone tissue provided such a favorable nidus then it is strange that artificial autoplasmic implantations of thyroid tissue to the long bones have not been followed by such proliferative and destructive growth Then too if normal thyroid cells possess such an unlimited potentiality for growth in distant tissues and organs the remarkable infrequency of this occurrence argues against its probability

The question might be asked if these are metastases of malignant epithelial tumors of the thyroid gland why do they not appear earlier in the regional cervical lymph nodes? Experience has shown that the metastases of thyroid carcinomata are almost entirely hematogenous and that distant dissemination is usually out of all proportion to the local lymphogenous metastasis

An analysis of the reported cases indicates that the metastases while most frequently of slow growth are not delimited but in

filtrate the neighboring tissues in an irregular fashion. The frequency with which osseous metastases have produced spontaneous fractures indicates that these metastases must infiltrate and produce bone absorption in the same manner as those neoplasms concerning which there is no question as to their frank malignancy. In our series of collected cases pathological fracture occurred 12 times and of these 7 were femoral and 5 were humeral.

#### PREDILECTION FOR OSSEOUS METASTASIS

The striking predilection of secondary epithelial tumors of thyroid origin for growth in bones particularly in the cancellous vertebral bodies and in the diploe of the cranial bones is manifested in the reported cases of metastasizing goiter. The following table represents the relative frequency with which the various bones were involved.

|           |          |          |         |
|-----------|----------|----------|---------|
| Skull     | 30 times | Femur    | 9 times |
| Vertebrae | 25 times | Ribs     | 7 times |
| Pelvis    | 11 times | Humerus  | 7 times |
| Clavicle  | 9 times  | Scapula  | 3 times |
| Sternum   | 9 times  | Mandible | 2 times |

In every case but 4 it was the bone tumor which produced the symptoms which caused the patient to seek medical aid. In this way they simulate carcinomata arising in the prostate and renal hypernephromata which frequently give signs of osseous metastasis before the primary new growth has been discovered.

Most of the thyroid bone metastases have been diagnosed clinically and roentgenographically as sarcomata. This emphasizes the need of considering secondary tumors particularly those originating in the thyroid prostate breast adrenal and kidney in all cases of skeletal new growth.

Two interesting observations that may possess diagnostic significance are the presence in the metastases of visible and palpable pulsations synchronous with the heart beat and the tendency of the metastases to fluctuate in size during menstruation and pregnancy. Bruit has been heard on auscultation over many of the pulsatile osseous metastases. Pulsation is a particularly prominent

feature in those metastases which arise in the diploe of the squamous cranial bones and erode the inner table of the skull and come to lie on the dura mater. Several instances have been reported in which a pulsating thyroid metastasis in the sternum or clavicle has been mistaken for aortic aneurysm. Recurrence following attempted extirpation of solitary osseous metastases is common even though the clinical evidence of recurrence may not appear for many years. Because of this tendency toward recurrence and spontaneous fracture with non union and in view of the relatively slow growth of thyroid carcinomata amputation seems to be the most rational treatment in those cases in which the long bones are involved.

The reports of three cases from this laboratory tell us much regarding the manner of growth of thyroid tissue in bones. The first case illustrates quite convincingly the great variability in the histological appearance of the metastatic thyroid tissue. The second case was reported (1913) soon after the discovery of apparently normal fetal thyroid tissue at the site of a spontaneous fracture of the femur as another instance of metastases of normal thyroid tissue. The third case is likewise in striking analogy with the previously reported cases of benign thyroid tumors with metastasis.

#### REPORT OF CASE WITH VERTEBRAL METASTASIS

Mr H F age 66 was admitted to the neurological clinic on January 28 1910 complaining of sharp shooting pains and weakness in the shoulders and arms. The pains began during April of the preceding year and at first involved only the left shoulder and arm. In December weakness of the left upper extremity was noticed for the first time. During the month before admission the right upper extremity was similarly affected. He experienced a feeling of weakness in the lower extremities during the same period.

On physical examination the left pupil was smaller than the right. The forearms and hands were somewhat atrophied especially the thenar eminences. Flexion and extension at the elbow and wrist and the hand grip were weakened. There was anesthesia to light touch on the ulnar side of both hands involving the entire fourth and fifth fingers and the ulnar half of the third finger. Triceps reflexes were absent on both sides. There was diminution in faradic irritability in the triceps and

on the ulnar side of both hands and forearms. There was no atrophy of the lower extremities. The movements of flexion and extension at the knee and ankle joints were weak, particularly on the left. The toes of the left foot were moved with difficulty. The knee jerks were exaggerated on both sides, more so on the left. Bilateral ankle clonus and the Babinski reflex were present on both sides. Sense of motion and position of toes was lost. Just to the left side of the midline of the neck, posteriorly at the level of the sixth cervical vertebra, was a tumor of walnut size. It was sharply circumscribed and the skin was freely movable over it. It was not tender to pressure. The patient had no idea how long it had been there.

The patient was transferred to the Surgery Clinic for operation with a diagnosis of tumor pressing on spinal cord at about the sixth to eighth cervical segment. Laminectomy (fourth, fifth, sixth cervical vertebrae) revealed the presence of a soft reddish hazel nut sized extradural tumor apparently originating in the left side of the body of the sixth cervical vertebra. It was easily separable from the dura, with which it was in immediate contact.

Histopathological examination of this tumor showed many islands of colloid containing alveoli surrounded by a single layer of flattened epithelial cells. Other areas showed a papilliferous structure with taller columnar cells and little or no colloid. The pathological diagnosis was papilliferous adenocarcinoma of thyroid origin. For many years the patient had possessed a small soft symmetrical goiter which had never occasioned him any difficulty and which had not manifested any recent growth. Clinically there was no evidence of malignancy.

Following the removal of the spinal cord tumor many of the signs of spinal cord compression disappeared.

Seven months later the patient again appeared at the hospital with a return of the original symptoms showing considerable loss of weight and strength. The thyroid gland had not changed in size or consistency during the interim.

Exploratory operation was done at the site of the original laminectomy and the small bit of tissue removed showed microscopically only scar tissue and fat. The clinical diagnosis at this time was tumor of the spinal cord, probably return malignancy. The patient died 2 months later.

At autopsy the bodies of the sixth and seventh cervical and the first thoracic vertebrae were filled with a soft reddish spongy vascular mass which was compressing the spinal cord in this region. The thyroid gland was but slightly enlarged, firm and nodular with no definite infiltration to neighboring tissues. On section there were firm whitish areas which yielded abundant tissue juice on scraping. A few of the cervical lymph nodes and the thymus contained small nests of similar tissue. Microscopic study showed the whitish areas in the thyroid to be made up of a primary papilliferous adeno-

carcinoma probably originating in a papilliferous adenoma. The metastases to the vertebrae (Figs 1, 2 and 3), cervical nodes and thymus showed many similar carcinomatous areas, but there were large areas which looked exactly like normal thyroid tissue with follicles of various sizes filled with homogeneous colloid and surrounded by a single layer of low cuboidal cells without mitoses or hyperchromatism or pluristratification or any other evidence of an abnormal growth tendency. This extraordinary variability in the histological appearance of the metastases is a constant finding in all of our autopsied cases of frank carcinoma of the thyroid and many authors have emphasized it notably Bell (3).

Certainly histological examination of such innocent appearing masses at the time of operation would have given as much evidence in favor of a benign metastasizing goiter as has obtained in many of the cases reported as such particularly in view of the apparent clinical innocence of the thyroid gland during the long period of observation. Yet the evidence of malignancy in this case is established beyond a doubt.

#### REPORT OF CASE WITH FEMORAL METASTASIS

A woman of 69 entered the surgery clinic for treatment of a femoral fracture which had occurred 6 months previously. All attempts to promote healing had been fruitless. For 4 months prior to the fracture she had experienced painful sensations in the left leg and thigh. One day while engaged in her household duties she fell to the floor without any apparent reason and upon attempting to arise discovered that she had sustained a spontaneous fracture of the left femur just above the knee.

Exploratory incision was done to ascertain the cause of the delayed healing. Considerable soft gelatinous reddish tissue was found between the fragments. This tissue seemed indistinguishable from that seen previously by the surgeon in cases of bone sarcoma, so high thigh amputation was done.

Microscopic study of the tissue between the bone fragments revealed acini of varying size surrounded by a single layer of cuboidal cells and filled with homogeneous colloid. The nuclei showed neither hyperchromatism nor mitotic figures. Many of the acini were small and devoid of colloid having much the appearance of normal fetal thyroid tissue (Fig. 4). There was little to suggest a rapidly proliferating malignant growth. Because of its innocent morphology it was thought to be a metastasis of normal thyroid tissue. The pathological report was received with great surprise and the surgeon's attention was directed toward the thyroid gland. A small goiter common to this district was found. The patient insisted that it had been there since girlhood and that it had actually diminished in size during the last few years. Clinically there was no evidence of malignancy.

This case was reported by de Nancré in 1913 as a case of metastasis in the femur of normal fetal

thyroid is (90) Through extensive correspondence with the patient's relatives and family physician and examination of the death certificate it has been learned that this patient subsequently developed a rapidly growing hard irregular goiter with infiltration to the neighboring neck tissues and progressive signs of dyspnea, dysphagia and aphonia. Death occurred within 18 months of the operation from unquestionable carcinoma of the thyroid gland. Unfortunately no autopsy could be obtained.

#### REPORT OF CASE WITH METASTASIS TO ASTRAGALUS

This case has many points of similarity to the preceding one. A middle aged man complained of severe pain in his right foot and a feeling that the bones of his foot were giving away. The roentgenological examination showed a distinct diminution in density in the astragalus and the diagnosis of sarcoma was suggested. At operation the bone was soft reddish with much the appearance of firm currant jelly and cut with the resistance of cheese. Microscopic study of the tissue revealed the presence of typical thyroid tissue. Healing occurred *per primam* and the patient left the hospital. At this time the thyroid gland presented a small symmetrical soft enlargement with nothing to suggest malignancy. This case was likewise believed to be one of simple goiter with metastasis. Had this case been reported immediately following the operation it might well have been considered another instance of benign metastasizing goiter. Two years later this patient died an asphyxiated death with undoubted clinical evidence of carcinoma of the thyroid gland. The patient had left the hospital and necropsy was not done.

These last two cases might well have been considered instances of metastasis of normal thyroid tissue early in their clinical course. The ultimate exodus with frank carcinoma of the thyroid gland indicates that the microscopic appearance of the secondary growths is not a dependable criterion. No single case in the literature offers complete and convincing evidence of the innocent character of the tissue from the thyroid gland or of its metastases.

A study of the literature concerned with thyroid carcinomata indicates at once that great uncertainty has existed as to what constitutes malignancy in primary thyroid new growths. There can be no doubt but that the metastases of thyroid carcinomata are subject to the greatest variability in microscopic appearance. This is as true in cases of undoubted carcinoma as it is in those which

have been called "benign metastasizing goiter." It is this variability that has most frequently led to the contradictory diagnosis of innocent goiter with metastasis. To consider the possibility of such a circumstance as a benign neoplasm giving rise to multiple metastases is to question the validity of the few fundamental facts which we possess regarding malignant new growths.

It would seem, therefore, with this abundance of evidence in contradiction to the benign metastasizing goiter theory that there is no such entity and that they represent in fact instances of unrecognized carcinoma of the thyroid gland with metastasis.

CASE 1. Almartine and Jaboulay (12) report the case of a woman aged 23. There was pain and limitation of motion of the right arm with a pulsating tumor in the upper right humerus which had reached the size of an orange. The patient had lost weight and a bruit could be heard. A diagnosis was made of aneurysmic sarcoma of the humerus. The upper humerus was resected. Microscopic examination showed typical thyroid tissue.

A goiter had begun 2½ years previously and had reached tangerine size. It fluctuated with menstruation. There had been no modification in size during the development of the humeral tumor. No Basedow disease, no myxodema.

Over a year after the operation Almartine and Bonnet (13) reported. There had developed right sided sciatica with disturbances of sensibility and muscular atrophy pain on pressure over the upper extremity of the femur. Weakness of the lower extremities, spontaneous fracture of the neck of the right femur while in bed, complete paraplegia, urinary retention (vertebral metastasis), painful left thigh and cystitis. Progressive cachexia was followed by death. No microscopic examination of the metastases to the right femur or vertebra was made.

The thyroid gland underwent no change during the 19 months which had elapsed between the resection of the upper humerus and death, and no microscopic examination of it was made. No autopsy was performed.

CASE 2. Beilby (14) Male aged 65. A tumor had obstructed the right nostril for 6 months. A diagnosis was made of sarcoma of the antrum of Highmore and incomplete extirpation done. Microscopically the growth was typical thyroid tissue and areas showed solid cellular appearance. The growth increased rapidly following operation. Death occurred 8 months after onset.

There was no hypertrophy of thyroid before or after operation. No histological examination nor autopsy was made.

CASE 3. Bell (5) A man aged 48 had pain in the right hip joint for several months. The right femur fractured spontaneously while patient was in bed. A tumor then developed in the left iliac region. Death occurred 2½ years after the onset of illness. Autopsy. Femoral metastasis showed macroscopically a structure resembling undeveloped fetal thyroid. The acinar strangeness was easily recognizable. The tumor was lined by cuboidal cells and contained thin colloid. Certain areas showed the same structure as thyroid adenomata. The iliac metastasis presented vesicles like those of normal thyroid but much more evident.

The thyroid showed neither general nor local enlargement. On section of the right lobe three follicles sized nodules appeared. Microscopically two nodules show irregular arrangement of cells, change in shape, absence of colloid and embryonic character of blood spaces all suggest malignant a leucoma.

**CASE 4.** Hontsch (Osmolowsky) (4). In a woman aged 53 a rapidly growing firm painless tumor developed in the right frontal bone 4 to 6 weeks after a blow received 6 months previously. It reached hazel nut size. Extirpation had to be done in two stages because of severe hemorrhage.

A pulsating grayish red tumor extended to the dura mater a portion of which was removed with the firmly adherent tumor. Microscopically there were variously sized acini filled with colloid grouped in follicles separated by vascular connective tissue. There were no solid cell masses. It resembled ordinary thyroid gland. The patient was in excellent health 3 years later. The thyroid showed large thickening particularly the right lobe. There was no change during the 3 years after operation. *No microscopic examination and no autopsy was made.*

**CASE 5.** Carle (5). A woman aged 50 had a pulsating tumor in the sternal region. Extirpation was followed by tetanus and death occurred 14 days after operation. *Autopsy.* The sternal tumor gave the appearance of alveolar cancer. There were many small metastatic nodules in the lung with typical thyroid structure.

Goutier had been present for 25 years. *No microscopic examination was made.*

**CASE 6.** Coats (6). Woman aged 46. There was a soft distinctly pulsatile swelling over the external occipital protuberance of 1 1/2 years duration. It was painful and fluctuated markedly but averaged pigeon's egg size. *Death.* 11/10/1901. Bone absorption (1 1/4 inches in diameter) had taken place in the region of the external occipital protuberance. The tumor was red and soft. Another tumor 1 inch in diameter involving the parietal bone both tables and diploe was firmly adherent to the brain with pressure on the brain. There was present a third tumor in the right parietal bone (3/4 inch in diameter) and two smaller areas nearby. Microscopically they were typical thyroid sacculi. Sometimes the epithelium fills the sacculi.

The patient had had goiter for 16 years, the goiter being larger on the left. Inability to swallow or speak had gradually developed. At autopsy both lobes were found enlarged with much calcareous deposit. Microscopically it was similar to the skull showing changes common in endemic goiter.

**CASE 7.** Cohnheim (7). A woman aged 35 had multiple gelatinous metastases in the lungs and bronchial nodes. The second, third and fourth lumbar vertebrae contained raspberry jelly like masses. The right femur and the left sacro-iliac junction were similarly affected. All showed the structure of colloid goiter with many follicles showing epithelial nests within the colloid.

Both lobes of the thyroid gland were enlarged, especially the left. The left lobe showed two large nodules which on section presented the same structure as that of the nodules in the lungs, bronchial nodes and bones. There was no infiltration of the surrounding tissues. The smaller of the two nodules had a small duct like projection into a tributary of the inferior thyroid vein which was histologically similar to the metastatic nodules.

**CASE 8.** de Cruyts (8). A man aged 58 about a half year before examination noticed a pulsating tumor in the right gluteal region. He had previously felt intense pain in the upper right thigh radiating to the calf and foot. The right pelvic bone was swollen to the size of two fists not circumscribed soft strong pulsation. Diagnosis

aneurism of superior gluteal artery. At operation a very vascular tumor was removed with the curette. Death occurred 3 hours after operation. *Autopsy.* Microscopically the tissue showed closely placed cavities of different size, surrounded by a single row of cubical epithelium with large round nuclei filled with homogeneous colloid. There were dense connective tissue septa and infiltration and absorption of bone.

The patient had a small palpable goiter but no enlarged regional lymph glands. At autopsy the thyroid was not much enlarged. In the upper right lobe was a cherry sized brownish nodule. In the middle of the right lobe was a pea sized encapsulated light yellow nodule. In the left lobe was a round nut-sized encapsulated nodule. Microscopically the left thyroid nodule showed regularly placed, variously sized vesicles covered with small cubical cells and filled with homogeneous colloid. The nodule was encapsulated. No infiltration was present. The smaller right pea sized nodule contained cells of medium size containing very little protoplasm, large round nuclei, some mitotic figures, cells deposited in solid strands and heaps radiating irregularly. A few small follicles were filled with colloid. The capsule was infiltrated by tumor cells. A diagnosis of adenocarcinoma was made.

**CASE 9.** Cruve (9). A woman aged 75 for 25 years had had a swelling and pain in the left shoulder. Two years previously she had sustained a fracture of the left humerus without healing. She was emaciated. During resection a tumor was found which reached the vascular nervous plexus. The humerus fractured during manipulation. Healing occurred. In the fist sized tumor (9 by 6 centimeters) of the upper shaft of the humerus could be seen grossly colloid containing follicles. Microscopically it was encapsulated by a cellular vascular connective tissue. There was no infiltration of the capsule. It was for the greater part a benign colloid goiter with areas of old and fresh hemorrhage. There were areas of smaller follicles with less colloid and cylindrical epithelium (goiter pseudo-chymatosa) and many strands of epithelial cells simulating adenocarcinoma.

The patient had had an enlarged thyroid for many years but no recent accelerated growth. She gave no complaints. The goiter nodule was hard and movable. There were no signs of compression and no recurrent nerve paralysis. Clinically it was a benign goiter. The goiter showed no change during the year following operation. *No autopsy and no microscopic examination was made.*

**CASE 10.** Decum (10). A woman aged 56 one year following partial thyroidectomy had shooty pains and progressive wasting of the left upper extremity. Later there were pains in the right hip followed by gradual contracture of the right lower extremity. The left lower extremity was ultimately similarly affected. Then the right upper extremity showed wasting with severe pain. There was marked kyphosis in the dorsal and lumbar regions. There was a tumor at the sternal end of the left clavicle. The Balinski reaction could be elicited on the right side. There were multiple areas of paresthesia and multiple trophic ulcers. *Death.* At autopsy there were red fleshy gelatinous tumors of the sternum, eighth and ninth dorsal vertebrae, sacrum, second lumbar vertebra and skull. The spinal cord was flattened by a tumor of the fourth and fifth cervical vertebrae. Microscopically (only cori and cervical tumors were examined) all revealed typical structure of the thyroid although lined by a single row of cubical epithelium and filled with characteristic colloid material. Patient had had a goiter for many years. Partial thyroidectomy had been done 6 years ago for aphonia and dyspnea. Grossly the tissue was normal thyroid. *No microscopic examination was made.*

CASE 11. Devic and Berel (11). A woman aged 54 entered the hospital with signs of myocardial failure and died 2 hours later. *Autopsy*. There were edema of the lower extremities and cardiac hypertrophy. In the right ventricle was an elliptical tumor measuring 18 by 13 millimeters near the pulmonary valve which was lighter in color and softer and more elastic in consistency than the surrounding tissue. It resembled a uterine myoma. Histologically it was thyroid tissue with large and small follicles filled with colloid. The surface was covered by intact endocardium. It was separated from the myocardium by fibrous tissue of varying thickness but continuous. There were areas of firm connective tissue containing nests of epithelial cells arranged in minute vesicles without colloid. At one point between the muscle bundles in the immediate neighborhood was a small circumscribed nest of thyroid follicles.

The thyroid gland was normal in size and presented no abnormalities. *No histological description was given.*

CASE 12. Threl (12). A woman aged 53 had a tumor of hazel nut size on the right parietal bone. Signs of cerebral compression appeared 3 years later. The tumor grew to be the size of a child's head, was fluctuating and elastic. No further tumors were detected clinically and no operation was performed. Death. *Autopsy*. The parietal tumor infiltrated the dura mater. There were several pea sized nodules in the lung—soft yellowish marrow like. Microscopically the picture of a simple colloid goiter predominated though single cell heaps without glandular form were present. Lung metastases showed similar structure.

The patient had a small goiter which had been stationary for many years and had remained unchanged during the 3 year interval. Histologically it was a simple colloid goiter. However there were present numerous solid strands and heaps having carcinomatous characteristics.

CASE 13. von Iselsberg (13). A man aged 72, 6 years previously had received a blow on the sternum followed by a hard tumor which reached egg size. Extirpation was followed by death. Microscopically it consisted of vascular tissue with some cystic colloid formation.

The thyroid gland was slightly enlarged. In the left lobe there were some hard nodules. The left lobe showed the structure of colloid goiter.

CASE 14. von Lelsberg (14). A man aged 38 had a fist sized tumor in the midline between the parietal bones with many dilated vessels. The tumor enlarged when he bent over. It was diagnosed as sarcoma and extirpated. It was found to be adherent to the dura. Microscopically it was a typical adenoma of the thyroid with some colloid development. There was a recurrence 4 years later. The patient was alive 5 years after operation.

The patient had had a goiter since the age of 20 years. There was no enlargement during the postoperative period of observation. *No microscopic examination.*

CASE 15. Emmersch (15) reports the case of a man aged 63 with metastases to the sternum, spine and pelvis. Microscopically the tissue was normal thyroid.

CASE 16. Ewald (16). A woman aged 45 had pain in the angle of the right scapula. A tumor appeared reaching fist size in a year. The diagnosis was metastatic goiter. The tumor of the scapula, after extirpation measured 11 by 6 centimeters. It was yellow brown cystic nodular. Microscopically there were many follicles covered by simple cuboidal epithelium and filled with colloid. There were atypical proliferating cell masses as in adenocarcinoma of the thyroid gland.

A goiter of 4 years duration reached orange size and was removed 1 year previously. A nodule then appeared

in the right lobe and was extirpated. Some infiltration aroused suspicion of malignancy. The structure was that of simple colloid goiter. *No aut. psy.*

CASE 17. Fabriz (17). Woman aged 37. Symptoms of compression of the spinal cord first appeared 1 year before death. There was a soft red lish elastic tumor of the body of the third dorsal vertebra of hen's egg size with compression myelitis. Death was from bronchopneumonia. Histologically the tumor was thyroid tissue partly colloid partly parenchymatous with vascular connective tissue. There was complete absorption of bone. The follicles did not possess the histological characteristics of malignancy.

There was an old unilateral goiter without adherence to the neighboring tissues. Histologically it presented all the characters of benign thyroid adenoma. It was impossible to find any indication of malignant degeneration.

CASE 18. Feuer (18). A woman aged 58 within 1 year following trauma developed a large fist sized pulsating tumor over the left parietal bone which penetrated the skull. It was diagnosed sarcoma and partially extirpated. Bleeding was profuse. Recurrence was followed by death 10 months after operation. Microscopically the tissue was identical with that of colloid goiter.

The patient had a small fist sized goiter. Microscopically it was a simple colloid goiter. *No autopsy.*

CASE 19. Flatau and Koehlichen (19). A girl 17 years of age 1 month previously had had vertigo vomiting Romberg's sign visual impairment and headache. The reflexes were normal. A diagnosis was made of cerebellar tumor. In the right occipito-temporal region was a small soft tumor mass distinctly pulsatile with bruit. Death occurred in 4 months. *Autopsy*. The tumor had eroded the bone below the external occipital protuberance. There was compression of the cerebral convolutions and invasion of the right cerebellar hemisphere. Microscopically the tumor showed alveolar structure rich in colloid abundant connective tissue and numerous mitotic figures.

The thyroid gland was enlarged especially the right lobe which contained a firm encapsulated nodule. Histologically it presented the picture of normal thyroid tissue alveoli filled with colloid and covered with a layer of flattened cells.

CASE 20. Foerster (20). A woman aged 49 showed signs of compression myelitis due to a pulsating vertebral tumor simulating aneurism. Cystitis a large decubitus and septic fever developed followed by death. *Autopsy*. Metastasis replaced the sixth thoracic vertebra compressing the spinal cord. There was a metastasis in the sixth left rib the size of a child's fist. There were metastases to the third fourth and fifth thoracic vertebrae and multiple pulmonary metastases. Microscopically there were many areas resembling normal thyroid tissue. Other areas resembled adenocarcinoma with ability to form rich colloid.

The patient had a large medium sized goiter. The nodules in the right thyroid lobe became smaller prior to death and became intensely hard. There was no infiltration. *No microscopic examination was made.*

CASE 21. Gierke (21). A man aged 57 experienced 4 years previously radiating pains in the hip joint with hematuria. A diagnosis of renal calculus was made. For 2 years there had been a stinging sensation in the right fifth intercostal space then pains in the sixth and seventh interspaces. Finally there was a girdle sensation around the chest and spastic paraplegia of both lower extremities with cramping pains in the lower trunk. The abdominal muscles became paralyzed and there was anesthesia of the lower half of the body. Ankle clonus developed but there was no vertebral deformity. A large sacral decubitus with septicemia led to death. A clinical diagnosis was made of myelitis transversalis dorsalis of unknown etiology.

**Autopsy** On the right side of the fifth dorsal vertebra and rib was a stucco sized tumor infiltrating the muscle which grossly resembled goiter. It extended into the spinal canal and compressed the cord. In the first lumbar vertebra a tumor the size of a hazel nut extended into the spinal canal. In the right posterior thorax in the mid axillary line a tumor the size of a fist extended from the fourth to the sixth rib. The ribs were invaded and the tumor was continuous with the vertebral tumor. The fifth and sixth thoracic vertebrae were destroyed by the tumor. The gross pathological diagnosis was primary vertebral sarcoma. Microscopically the center showed large colloid filled follicles—areas suggesting parathyroid glands but no areas suggesting carcinoma. The periphery showed many proliferating cell masses. There was muscle infiltration. The lumbar metastasis was similar.

The thyroid gland was slightly enlarged and grossly rich in colloid. In the right lower pole was a pea size nodule with hyalinization and calcification similar to benign adenoma. Microscopically the thyroid nodule showed small solid follicles similar to fetal adenoma. There were no tumor thrombi. The capsule was intact and there was no lymph node invasion.

**CASE 22 Gierke (22)** A man aged 46 had stitching pains in the sacrum for 4 years. A clinical diagnosis of compression myelitis of 1½ years duration was made. At the level of the third dorsal vertebra, kyphosis developed. In the first lumbar vertebra was a tumor the size of a fist of 2 years duration. Microscopically the picture was that of colloid goiter with colloid more compact than in the previous case. From 3 to 5 milligrams of calcium iodide were found in 20 grams of tumor.

The thyroid gland presented a normal appearance. *No microscopic examination was made.*

**CASE 23 Goebel (23)** A woman aged 54 fell 21½ years previously and fractured the femur which healed with shortening. Three months later she fell again and the femur fractured spontaneously. No consolidation followed. At operation a mass was found in the bone which infiltrated the muscle. It was diagnosed sarcoma. Microscopically it was a thyroid adenoma with polymorphism of cell cords and solid epithelial nests. An area of thyroid metastasis was found in the bone marrow at a lower level.

The patient had a goiter of moderate size. *No microscopic examination and no autopsy was made.*

**CASE 24 Guibé and Leguier (24)** A woman aged 51 complained of pains in the right shoulder. A pulsatile tumor the size of a chicken's egg was in the outer third of the right clavicle. It was extirpated. Sixteen months later there was no recurrence. Microscopically it simulated thyroid structure with abundant homogeneous material giving color reactions of colloid.

The thyroid gland showed no enlargement and no signs of malignancy. *No microscopic examination. No autopsy.*

**CASE 25 Gussenbauer (25)** reports the case of a woman with a soft and fluctuant mass in the region of the tenth, eleventh and twelfth thoracic vertebrae. There were pains in the lower extremities and finally paraplegia. Kyphosis developed. Local recurrence followed operation. Microscopically it was a typical thyroid adenoma.

The thyroid gland was large particularly on the left. It was clinically benign. *No microscopic examination. No autopsy.*

**CASE 26 Halbronn (26)** A woman aged 63 had a tumor of the sternum 8 by 10 centimeters with expansile pulsations synchronous with the radial pulse. A diagnosis was made of aneurysm of the ascending aorta. Death occurred 3 years after onset. **Autopsy** There was no connection between the thyroid and sternal tumor. The

tumor involved the right sternoclavicular articulation and clavicle. Microscopically there were many vesicles filled with colloid and surrounded by flattened cells. There were other areas of large irregular cells irregularly infiltrating neighboring tissues.

The patient had had a soft goiter of fist size for 4 years. Microscopically it presented the classical aspect of benign goiter throughout.

**CASE 27 Halpérine (27)** A man aged 54 had a small tumor of the clavicle of 10 years duration. He was in good health. Following traumatism the clavicular tumor grew rapidly to the size of a small fist and was extirpated. Microscopically the structure was that of thyroid.

The patient had a goiter which was larger on the right. *No microscopic examination. No autopsy.*

**CASE 28 Harmer (28)** In a woman 44 years of age a tumor slightly larger than a nut appeared on the right side of the face 2½ years previously with no marked increase in size. She complained of headache and nasal obstruction and lid ptosis. There was decreased visual acuity in the left eye when the right and bilateral optic atrophy. In front of the left nares was a hard reddish gray cherry sized movable tumor on the right was a fist tumor reddish gray and 4 ft. The right choana was filled with a polypoid mass. Extirpation was followed by recurrence. Microscopically there were masses of cubical and polymorphous epithelial cells arranged in solid surrounding colloid masses.

A goiter slowly developed at the time the sphenoidal tumor appeared and later rapidly increased to the size of a man's fist. There were palpable glands behind the thyroid. There were no difficulties in breathing or swallowing resulting from the thyroid enlargement. *No microscopic examination. No autopsy.*

**CASE 29 Howard (29)** A woman 30 years of age had on the vertex of the skull a firm elastic orange size tumor of 7 months duration. At the external border of the left scapula was a soft mound smooth tumor 3 inches in diameter. There was a similar pulsatile tumor of the left ilium. Anesthesia and paresthesia were present below the seventh rib. Death occurred 1 year after the onset of symptoms. **Autopsy** The cranial tumor rested on the dura. On the posterior surface of the seventh cervical vertebra a similar growth projected into the canal and exerted pressure on the spinal cord. Metastases were found in the liver, spleen and kidney and all showed alveoli, many were filled with colloid and were covered by a single layer of cubical cells resembling normal elements of thyroid gland.

The thyroid gland had recently enlarged after 21 years of quiescence. At autopsy a firm tumor was found compressing the trachea which resembled ordinary goiter.

**CASE 30 Heilbing (30)** In a woman 51 years of age a tumor the size of a hazel nut had appeared in the manubrium sterni 11 years previously. It was not capable long before the thyroid enlargement appeared. Seven years previously it had reached the size of an apple with lively pulsations and was compressible. A diagnosis was made of aortic aneurysm. For 3 years she had had pains in the back and sacrum terminating in weakness and stiffness of both legs, and urinary and fecal incontinence. While she was lying in bed the upper right femur had fractured spontaneously. A fusiform swelling appeared at the point of solution of continuity. The sternal tumor reached fist size. She died of ascending infection of the urinary tract. **Autopsy** The sternal tumor resembled grossly the goitrous thyroid. A tumor the size of a dove's egg was found in the seventh thoracic vertebra compressing the spinal cord. In the region of the pathological fracture was a raspberry jelly

like mass. Microscopically all the tumors showed goiter tissue without signs of malignant degeneration.

The 11th thyroid lobe became enlarged to apple size. At autopsy the thyroid was found completely encapsulated with right sided goiter. Microscopically the tissue was simple goiter without evidence of malignancy.

CASE 31. Heschl-Wolfer (31). A man aged 35 had metastatic nodules in the lung, the structure being that of thyroid vesicles.

There was a tumor of the thyroid the size of an infant's head. Extirpation was followed by recurrence 2 years later. At the second intervention death followed 3 days after operation. Autopsy. Microscopically the tissue from the first operation was thyroid adenoma (Heschl) from the recurrence intermediate forms between adenoma and alveolar cancer, some areas being typically alveolar.

CASE 32. Hinterstoisser (32). A man 38 years of age had symptoms of chronic meningitis. At autopsy a large tumor was found involving the base of the skull and the entire sphenoid bone. Microscopically this was an adenocarcinoma of thyroid origin with many large follicles and marked colloid development like that seen in normal thyroid tissue. There were multiple pulmonary metastases.

Only the left side of the thyroid gland was enlarged. It contained adenomatous masses.

CASE 33. Hinterstoisser (33) reports another case in which there were multiple metastases to the vertebrae, ribs, lung and lungs all colloid in type. There were also metastases to the skull, adenocarcinomatous in type.

In the enlarged lobes of the thyroid were many colloid nodules.

CASE 34. von Holmann. L. from Danbooy and Dhaflun (34). A woman 43 years of age had a rapidly growing tumor of the scapula which appeared 9 months after ablation of the thyroid nodule. It was extirpated but recurred in 2 years. There was a second intervention. Death occurred 2 years later without recurrence. Microscopically the first tumor was adenocarcinoma.

The patient had had goiter for 4 years. The nodule from the right lobe was extirpated 9 months before the scapular tumor appeared. Microscopically the mass was that of colloid goiter without malignant characteristics. *No autopsy.* An incomplete microscopic examination was made.

CASE 35. Hollis (35). A man aged 45 complained of severe headache, dizziness and vomiting of 6 months duration and finally paralysis of the lower extremities and anesthesia below the costal margin and the tenth dorsal vertebra and incontinence. The Babinski reflex was present. A large deep-seated rapidly growing tumor appeared behind the left clavicle and sternomastoid which diminished in size (Malignancy of accessory thyroid?). At autopsy a walnut sized tumor was found beneath the cerebral membranes to the left of the falx cerebri with compression of the brain. Similar tumors were found on the left side of the cerebellum and in the body of the third dorsal vertebra with pressure on the cord. There were metastases in the liver and adrenals. Microscopically the thyroid tumors showed areas of malignant growth especially those in the adrenals.

There was no enlargement of the thyroid. *No gross or microscopic examination* was made. The mass behind the left clavicle and the sternomastoid may well have been a carcinomatous accessory thyroid.

CASE 36. Honsell (36). Woman aged 20. In the frontal bone was a very slow growth the size of a pigeon's egg, extending to the dura. The microscopic appearance was that of colloid goiter without signs of malignancy. A cystic tumor had been removed from the same region 7 years previously.

A partial thyroidectomy of a fist sized left lobe was performed 2 years before the second appearance of the frontal tumor. There was considerable growth of the goiter in the interim. Microscopically the structure was that of colloid goiter with solid round or filiform islands of epithelium characteristic of rapidly proliferating cells. Occasional solid epithelial strands at periphery of tumor. *No autopsy.*

CASE 37. Huguenin (37). A man 58 years of age had severe pains in the back which began 1 year previously. Later there developed pains in the legs, stiffness, weakness and inability to move the legs actively. In an angular curvature in the middle of the back a soft fluctuating painless tumor was felt. Its presence was unknown to the patient. The patellar reflexes were exaggerated. Sensation was diminished below the umbilicus with urinary and fecal retention. There was a bilateral Babinski reflex with sacral detubitus and suppuration. Death. Autopsy. The tumor involved the sixth, seventh and eighth dorsal vertebrae and simulated an acute swelling of the spleen. The mass encroached on the spinal cord. Microscopically the sixth vertebra showed solid cell strands with polygonal round and spindle forms. The seventh showed the picture of thyroid gland of adult with many follicles filled with colloid and surrounded by a single layer of cubical and cylindrical epithelial cells.

At autopsy both lobes of the thyroid gland were somewhat enlarged the left (6 centimeters) more than the right (5 centimeters). The lower pole of the right lobe was intrathoracic. The capsule was intact. Microscopically throughout the picture was that of parenchymatous colloid goiter. After repeated searches a small whitish nodule (4 by 5 millimeters) was found in the lower pole of the left lobe. This area was definitely carcinomatous showing anastomosing cords of round and oval hyperchromatic cells.

CASE 38. Hutchinson (38). A woman 50 years of age had rheumatic pains in the left shoulder for 5 months following a fall. The swelling appeared in the upper third of the arm. At exploratory incision a small growth was found near the deltoid insertion. During operation the humerus fractured spontaneously. Amputation was followed by healing with death in 6 months. Cachexia was marked. Microscopically the picture suggested metastases of thyroid tissue as in Morris's case.

The thyroid gland was not examined and there was no autopsy.

CASE 39. Jaboulay (39). A man 60 years of age had a tumor of the clavicle near the sterno-clavicular articulation which had developed at the same time the goiter appeared. It was as large as the two neck tumors combined and was firmly adherent to the bone with crepitation on movement. At extirpation several small encapsulated thyroid masses were found behind the clavicle. *No histological examination.* *No autopsy.*

The patient had had a slight goiter for 2 years with more rapid growth during the past 14 months. It consisted of 2 masses in juxtaposition each the size of a tangerine. There were no signs of compression or Basedowism and no infiltration of the neck structures. It was clinically benign. Operation followed extirpation of the clavicular tumor when neoplastic infiltration of the trachea was found. *No histological examination.* *No autopsy.*

CASE 40. Jacobsen (40). A man 40 years of age 1 year previously experienced loss of sensation in the abdomen and hip, twitching of right leg and girdle pains around the abdomen. Babinski's sign was present with kyphosis of the second and third thoracic vertebrae. The X rays showed destruction of the third thoracic vertebra. The clinical diagnosis following extirpation of the thyroid



nodule was tumor vertebrae dorsalis (metastasis strumae benignae) cum compresse ionne medullae spinalis. Laminectomy was done. Microscopically epithelial proliferation was associated with areas of colloid and atypical gland cells—more malignant than the extirpated goiter nodule.

Thirteen years previously a goiter the size of a fist was removed surgically. The thyroid now contained a walnut sized hard nodule which was extirpated. Microscopically it was a follicular goiter with rich proliferation of follicles partly with solid strand formation. Colloid was scant and there were many atypical cells. *No microscopic examination was made of tissue from the first operation. No autopsy.*

CASE 41. Jaeger (41). In a woman 69 years of age following a fall a tumor developed in the sixth and seventh cervical and first thoracic vertebrae. Another tumor involved the third and fourth lumbar vertebrae. At operation on the lumbar tumor there was profuse hemorrhage. Microscopically the structure was that of benign adenoma.

The patient had had a freely movable goiter for 10 years. *No microscopic examination. No autopsy.*

CASE 42. Jellies (42) reports the case of a parietal subdural tumor composed of somewhat embryonal thyroid tissue.

The thyroid gland appeared to be entirely normal. *No microscopic examination. No autopsy.*

CASE 43. Joll (43). A woman 47 years of age had pain and weakness in the left arm and a tumor of the sternal end of the left clavicle. Healing followed extirpation. Microscopically appearance of innocent goiter; the vesicles are of regular shape and most of them contain colloid.

The thyroid gland had escaped attention until the nature of the clavicular tumor was discovered. There was a small firm freely movable tumor of the right lobe. *No microscopic examination. No autopsy.*

CASE 44. Kanoky (44). In a woman 40 years of age a tumor the size of a hazel nut had appeared 3 years previously on the left side of the head. Three months later it had reached 1 inch in diameter. Attempted surgical removal resulted in profuse hemorrhage. The tumor was not removed. The growth gradually increased for 2 years without symptoms then pain nausea vomiting paresthesia and transient paralysis of the left arm and leg developed. There was marked left exophthalmos with blindness. The left common carotid artery was ligated. The pulsations stopped and the tumor diminished in size. There was complete right sided hemiplegia 6 hours after operation with death 36 hours after operation. Postmortem a tumor 5 by 3 by 2 inches was removed. The bone was completely absorbed and the tumor extended to the dura. Microscopically it was like thyroid microscopically structurally identical with normal thyroid tissue no trace of malignancy.

An enlargement of the right side of the neck began 20 years previously. It grew to large size during the next 10 years and was treated with injections (phenol and iodine?). Two years later the right lobe was extirpated (intrathoracically). *No microscopic examination. No general autopsy.*

CASE 45. Knapp (45). A man 66 years of age complained of vertigo and diplopia. There was a pulsating soft tumor within the right upper orbital margin about 3 inches in diameter. At operation on it was found to extend to the dura. Microscopically it was (Crawford) adenoma of aberrant thyroid tissue. There was a recurrence a tumor 5 centimeters in diameter in the right scapula. The X-ray showed multiple nodules in the lungs and destructive processes in the eighth rib and pelvis. He died 3½ years after onset.

The thyroid gland seemed entirely normal. Later a circumscribed firm tumor appeared in the lower left lobe

(4 centimeters in diameter). *No microscopic examination. No autopsy.*

CASE 46. Kolb (46). A woman 75 years of age had a small tumor in the left parietal region which had developed 6 years after the extirpation of the goiter. It was a progressive growth vascular simulating hemangioma. There were no pulsations and no bruit. The clinical and radiological diagnosis was sarcoma. At extirpation it was found to extend to the dura a portion of which was removed with the adherent tumor. Death followed operation. *Autopsy.* There was a defect in the skull the size of a saucer. There were a few whitish pea sized nodules in the lungs. Microscopically the nodules in the lungs showed typical goiter structure. The parietal tumor was of the same architecture as the thyroid.

A goiter had been removed 7 years previously. It was normal in size at the time of autopsy, the right side being somewhat larger. Microscopically there were large follicles with no malignant changes.

CASE 47. Kraske (47). In a woman 53 years of age a small vascular tumor of the forehead appeared 6 weeks following trauma and extended through the frontal bone to the dura. It was removed at operation and there was no recurrence during 5 years. Microscopically it was normal thyroid tissue.

A large goiter removed unchanged during the 3 years following operation. *No microscopic examination. No autopsy.*

CASE 48. Langhans (48). Male 38 years of age. *Autopsy.* There were thyroid nodules and metastases of similar appearance in bronchial mediastinal and retroperitoneal lymph nodes lungs kidneys vertebrae sternum and ribs. The metastases in the lymph nodes showed the same histological structure as the thyroid nodules: colloid masses surrounded by cubical and sometimes cylindrical epithelium. Lung and pleura and kidney nodules showed the same structure.

There was a small cyst of the right thyroid lobe filled with hemorrhagic colloid fluid with several small nodules in the slightly enlarged left lobe. Microscopically the nodules contained vesicles of various sizes and forms the smaller ones surrounded by cubical epithelium and usually empty while the larger ones contained a pale colloid. The thickness of the epithelium pointed to a highly recent enlargement which presented the picture of colloid goiter.

CASE 49. Langhans (49). *Autopsy* on a woman 6 years of age revealed an anterior mediastinal node enlarged to a 3 centimeters in diameter hard grayish white and grayish red fairly transparent. There were many similar nodules in the lungs bronchial glands and choroid plexus. There was complete intimation of normal thyroid tissue in many of the secondary nodules. All showed structure of simple benign goiter. Some small vesicles without lumen or colloid appeared as solid cells. There was no tumor thrombosis or infiltration of the stroma. In one lymph gland were indifferently formed solid cell nests of carcinomatous appearance. Numerous lung nodules were more carcinomatous with solid cell strands and nests to either with numerous vesicles of 100 micrometer simulating normal thyroid vesicles. The choroid plexus nodules were similar to those in the lungs.

Both lobes of the thyroid gland were enlarged each containing several colloid nodules showing calcification. Grossly it was a simple goiter. Afteroscopically large and small vesicles were found filled with hining colloid surrounded by cubical and flattened epithelium.

CASE 50. Leecher and Masson (50). A man 67 years of age had strabismus for 7 years. A tumor mass the size of a adult fist in the left costal cartilage extended from the ninth rib to the diaphragm and into the pleural cavity

with no adherence to the skin. It was thought to be sarcomatous and was extirpated. Microscopically it was intermediate in form between fetal adenoma and colloid adenoma with more numerous mitotic figures than those ordinarily seen in thyroid adenoma. Following operation there were lancinating pains in the left thigh then paraplegia of the lower extremities urinary and fecal incontinence anaesthesia below the umbilicus (vertebral metastases) with death 3 months after operation.

There was a small tumor of the thyroid gland under the left sternomastoid rising with the larynx upon deglutition which was firm uniform in consistency smooth and not adherent. It had appeared a few months previously with no increase in volume. There was no clinical evidence of malignancy. No microscopic examination. *No autopsy*.

CASE 51. Litten (51) reports the case of an adenoma gelatinosum in the femur lumbar vertebrae and pelvis with malignant appearing metastases to the lungs and bronchial lymph nodes. The patient had a gelatinous goiter.

CASE 52. Meyer (52) A woman 48 years of age had a smooth painless tumor of the right temporal and parietal region which grew to 10 centimeters in diameter in 15 months. Recently the growth had been more rapid. The right thigh had fractured spontaneously with no union. The tumor of the cranium grew slowly and produced right exophthalmos. A bruit could be heard over it. Death occurred 2 years and 8 months after onset. *Autopsy*. There were metastases also to the bronchial and inguinal nodes and the lung. Microscopically the skull tumor showed for the most part typical thyroid vesicles with colloid content resembling normal thyroid. The bronchial nodules resembled atypical cells of the middle thyroid lobe. The inguinal nodes showed normal appearing thyroid tissue and small vesicles without colloid. The femoral tumor was made up of small colloid free vesicles. Test for iodine were negative.

The thyroid gland was enlarged mostly on the left (8 centimeters in diameter). At autopsy the left lobe was moderately enlarged but extended into an orange sized tumor just above the left clavicle. The right lobe was of walnut size. The middle lobe was enlarged and white. Microscopically the middle and left lobes showed small vesicles surrounded by atypically arranged cell heaps. Some parts contained normal colloid. It suggested transformation of adenoma into carcinoma.

CASE 53. Middeldorpf (53) A woman 36 years of age had a fluctuating large tumor of the left thigh of 1½ years duration with radiating pains in the foot and leg. Later a painful tumor of the occiput appeared and was partially extirpated. Microscopically the structure was that of thyroid adenoma. Eight months after operation spontaneous fracture of both thighs occurred and later fracture of both arms. The patient died 3 years after the onset with marked marasmus. At autopsy multiple small nodules were found in the lungs a fist sized occipital tumor penetrated the dura mater. There were other nodules in the lumbar vertebrae sacrum pelvis femora and humeri. Microscopically all showed the structure of benign thyroid adenoma.

In the left lobe of the thyroid gland was a small nodule the size of a pigeon's egg freely movable whose duration was unknown. It had not become augmented at any time. Histopathologically it was a benign thyroid adenoma but the rest of the gland peni at the caps te

CASE 54. Mignon and Bellot (54) A man 63 years of age had a pulsating tumor of the dorsolumbar spine which appeared after an injury and grew steadily for 5 years to the size of a large egg. There were lancinating pains in

the thighs and buttocks. At operation the spinous process and lamina of the twelfth dorsal vertebra were found entirely replaced by soft vascular tissue. Clinical improvement was followed by recurrence in 14 months with lancinating pains and trophic ulcers. A soft red friable mass 4 fingers breadth by 5 centimeters infiltrated the muscle. Death occurred 3 days after operation. Microscopically the mass resembled normal thyroid in part. Other areas were distinctly atypical.

The thyroid gland was moderately enlarged but had been disregarded during physical examination. There had been no change in volume for 13 months. Postmortem a small nodule of hazel nut size was found in the left lobe which gave a typical microscopical appearance of thyroid carcinoma. There was a partial autopsy only.

CASE 55. Morris (55) A woman 40 years of age had a large pulsating tumor of the left parietal region 6½ by 7 inches. It had appeared 2 years previously following mild traumatism. She died 6 years after the onset. Partial autopsy showed a skull defect 1¼ inches in diameter. The tumor rested on the dura. Microscopical examination of the parietal tumor showed a structure similar to thyroid gland colloid containing cysts surrounded by flattened cells.

There was some diffuse swelling of the thyroid. *No microscopic examination. Partial autopsy only*.

CASE 56. Muzio (56) A woman 48 years of age had a tumor in the right gluteal region which developed rapidly following trauma. In 2 years it had reached the size of an orange and was extirpated. Microscopically it was colloid goiter.

The thyroid gland had been moderately enlarged for 10 years. *No microscopic examination and no autopsy was performed*.

CASE 57. Neumann (57) A woman 54 years of age had an apple sized elastic tumor of the right arm just above the humeral condyles. The overlying skin was red and infiltrated there were no pulsations and the forearm was atrophied. There was abnormal mobility and crepitation of the humerus just above the elbow. A diagnosis was made of sarcoma with spontaneous fracture. Amputation was done and the patient died 24 days after operation of gangrene of the wound. Microscopically the tissue simulated the appearance of normal thyroid parenchyma spherical acini rich in colloid covered with simple cubical epithelium.

In the most of the size of a goose egg was removed from the left lobe of the thyroid gland. It had a hard fibrous capsule with calcification and cysts. Microscopically there were large follicles surrounded by flat epithelium and filled with colloid normal thyroid tissue for the most part and compact nests of rapidly growing cells in the connective tissue with tendency to form a single layer. *No complete autopsy*.

CASE 58. Oderfeld and Steinhilber (58) A woman 58 years of age had an egg sized elastic tumor of the left frontal bone replacing bone which had appeared 3 months previously. The growth was slow at first then rapid. The patient had had headache only during the last 2 weeks. The diagnosis was sarcoma. At operation a yellow brown vascular tumor was found extending to the dura. Convalescence was uneventful. Six months later (November 1900) there was no recurrence and the patient was in good condition. Microscopical examination showed alveolar structure with simple low columnar epithelium enclosing homogeneous colloid mass. The tumor was identical with normal thyroid tissue.

The thyroid gland was not enlarged and there were no accessory thyroids. *No microscopic examination was made*.

One half year later (June 1901) there was a recurrence the size of a chicken's egg in the left frontal bone. Simultaneously there appeared an apple sized tumor in the right temporal bone and a walnut sized tumor at the right sternoclavicular junction. The patient was markedly emaciated. Death followed the removal of the temporal metastasis. Incomplete autopsy (upper sternum, left clavicle, trachea, thyroid gland and frontal recurrence) showed microscopically a recurrence and the sternoclavicular nodule showed normal thyroid tissue.

The right lobe of the thyroid gland became enlarged as the recurrence and temporal tumor appeared. On section of the right thyroid a spherical nodule was found encapsulated. This nodule was recognized as the primary tumor anatomically. Histologically it resembled thyroid tissue. *No complete autopsy.*

**CASE 59. Patel (59).** A woman 65 years of age had a tumor of the left frontal bone (orbital margin) of 4 months duration. It was expansile, synchronous with the pulse. At extirpation it was found to rest on the meninges and to perforate completely the frontal bone. Microscopically there were areas reproducing normal thyroid and other areas showing the character of a thyroid carcinoma of high malignancy. There was a recurrence 8 months later.

For 30 years there had been a tumefaction of the thyroid gland with no recent augmented growth and no signs of malignancy. The tumor was uniformly hard, mobile and painless. *No histological examination was made and no autopsy performed.*

**CASE 60. Porcile (60).** A woman 46 years of age had a slowly developing tumor involving the inner third of the clavicle, sternoclavicular articulation and manubrium sterni with pains in the left arm. Extirpation revealed a grossly irregular spherical mass with a firm gray peripheral zone and a soft central zone. Microscopically follicles were surrounded by cubical and columnar cells and contained homogeneous colloid. Some areas showed the structure of adenoma, others were carcinomatous. Paraplegia was followed by death. There was a metastasis also to the seventh dorsal vertebra.

In the thyroid gland was a walnut-sized tumor firm, pusless, not adherent to the skin. The patient experienced no difficulties in respiration or deglutition. *No microscopic examination was made and no autopsy performed.*

**CASE 61. Paser (61).** A woman 42 years of age soon after thyroidectomy 6 years before examination developed weakness of the left leg followed by paresthesia. There was a feeling of pressure in the abdomen with pains in the right leg. A soft irregular swelling appeared at the right posterior iliac spine. At operation a soft grayish red tissue was found extending from the lumbar vertebrae. Paresthesia disappeared only to reappear a few days later. Six months later a hand size pulsating tumor appeared in the sacral region with rapid recent growth. The patient was bedridden and cachectic. Microscopically, the lumbar tumor showed long parallel strands with colloid deposit and large vesicles filled with colloid and surrounded by flattened epithelial cells.

Twenty years previously a small goiter had developed and had remained uniform for 14 years after which it grew rapidly and caused marked difficulty in swallowing. At operation all of it was removed except a portion of the left lobe. Microscopically it was a parenchymatous colloid goiter. At the time the case was reported the thyroid contained a nodule the size of a walnut in the middle with no fixation to the skin or the underlying tissues.

**CASE 62. Radley and Dugan (62).** The patient was a man 46 years of age. A small nodule had appeared in the right clavicle 6 months previously and grew to orange size

was smooth tense and showed visible pulsations. A reddish brown vascular soft tumor was excised. Histologically it was a secondary thyroid carcinoma with both solid and tubular acini. Tests for iodine were negative.

Two years before a small adenoma had been shelled out of the thyroid isthmus. It was normal in size, consistency and mobility with no evidence of malignancy. *No histological examination. No autopsy.*

**CASE 63. Regensburger (63).** A woman 53 years of age had had a painful swelling to the left upper arm 1 year previously which had gradually increased to the size of a man's fist. In the infraclavicular fossa were 2 hard glands of hazel nut size. The patient showed marked cachexia. A diagnosis of sarcoma was made. The upper third of the humerus was resected and the infraclavicular glands removed. Healing resulted. The tumor of the humerus 9 by 6 centimeters infiltrated the bone irregularly. The lymph nodes were replaced by whitish growth. Microscopical examination showed bone tumor and lymph glands. There were large epithelial cell masses some forming longitudinal rows. Many acini showed typical thyroid structure. Many papillae were covered with large cylindrical cells. The lymph nodes were similar. Chemical analysis showed no iodine.

In the middle lobe of the thyroid was a hard tumor the size of a prune. *No microscopic examination. No autopsy.*

**CASE 64. Reinhardt (64).** A woman, 58 years of age for 6 months had had pains in the right scapula radiating to the left arm. Later sudden paralysis of the lower extremities appeared. Laminectomy of the second to the fourth thoracic vertebrae was done. On both sides of the midline were hazel nut sized tumors of the vertebrae. Extirpation resulted in death during operation. Microscopically the tissue was simple benign parenchymatous goiter.

The patient had a large goiter with no growth for years. Clinically it was non malignant. *No microscopic examination. No autopsy.*

**CASE 65. Riedel (65).** The patient was a woman 40 years of age. Thyroid tissue was removed from the jaw with recurrence to years later.

There was no growth of the thyroid gland at the time of operation or during the 10-year interval. *No microscopic examination. No autopsy.*

**CASE 66. Riedel and Haackel (66).** A woman aged 43 had a deep-seated rapidly developing tumor mass in the midline of the maxilla. Hemisection of the jaw was done. Microscopically the tissue was typical thyroid. There was no recurrence 4 years later.

The patient had a large goiter at the same time which had been present for 30 years. *No microscopic examination. No autopsy.*

**CASE 67. Runge (67).** A woman 41 years of age 33 years before had felt a sudden cracking in the back of the neck accompanied by stinging pain. Rotation was limited the head felt to one side and flexion and extension were later limited. Active motion of the head was impossible. Simultaneously the right arm and leg became paralyzed. Later the left arm became paralyzed. A diagnosis was made of compression myelitis due to cancer tumor of the epistropheus. The patient died in the seventh month of pregnancy. Successful postmortem and caesarean section was done. *Autopsy.* There was a reddish tumor of the occiput around the foramen magnum, atlas and epistropheus. The main mass in the spinal canal originated in the epistropheus and infiltrated the muscle. Microscopically (von Recklinghausen) nests and strands of cells were spherically disposed in alveoli. Many were colloid-containing with a thin layer of flattened cells as in thyroid gland. (This was regarded by Cohnheim as similar to his case.)

This patient's neck was much deformed especially on the right with no enlargement of the cervical nodes. Swallowing of solid substances became difficult. At autopsy the thyroid was found much enlarged with many encapsulated adenomata. Microscopically there was no indication of malignancy.

CASE 68. Schmidt (68). A woman 57 years of age for 3 years had a tumor the size of a hazel nut at the lateral aspect of the left clavicle with recent accelerated growth. The regional lymph nodes were not enlarged. The growth was extirpated. Microscopically the appearance was that of benign goiter. After several searches a carcinomatous infiltration of the capsule was found. Death followed a few weeks after operation.

The thyroid glands were clinically normal in appearance. *No microscopic examination and no autopsy was made.*

CASE 69. Schräger (69). In this case a prearterial thyroid metastasis was found at operation for ureteral structure. It was thought to be a benign metastasis. Microscopically it was typical thyroid tissue.

No abnormalities of the thyroid gland were mentioned. *No histological examination. No autopsy.*

CASE 70. Gavel (70). A man about 40 years of age had been subjected to a previous operation on the pelvis for sarcoma. A recurrence was treated with Coley's tumors with no effect on the size of the tumor. Death was from exhaustion. The tumor involved the left greater trochanter of the femur and the left and right sacro iliac synchondroses. The tumor was pulsatile and compressed the bladder and rectum with ulceration of the overlying skin. Microscopically the tumor was typical thyroid tissue with alveoli filled with colloid.

No symptoms were referable to the neck. *No examination of the thyroid was made.*

CASE 71. Walther (71). A woman 49 years of age had an occipital tumor which was diagnosed sebaceous cyst. Extirpation was followed by recurrence and a second operation. A tumor 5 centimeters in diameter was found implanted in the occipital region attached by a pedicle to the dura mater. Microscopically the tumor was characteristic thyroid tissue.

The thyroid gland in the right lobe was hard and irregular. There was another large tumor in the left sternomastoid region apparently independent of the thyroid. These growths were removed. *No microscopic examination was made and the outcome was unknown.*

CASE 72. Wilkens and Hedren (72). The patient was a woman 72 years of age. Seven years previously tumors had appeared in the temporal region and on the summit of the cranium which grew to the size of an adult head soft fluctuant pulsatile. The only subjective symptoms were a buzzing in the ears and a slightly oblique vision. Cachexia was followed by death. A diagnosis was made of vascular osseous tumor. *Autopsy.* Cranial tumors had developed in the bone. On section they were grayish white with ecchymotic spots. A similar tumor was in the second third and fourth dorsal vertebrae. Microscopically the tissue was embryonic thyroid with polymorphous cellular elements rich in chromatin. The appearance was that of carcinoma.

A recent augmentation of thyroid was diagnosed goiter. It reached apple size and was firm and resistant. At autopsy the right lobe was found to contain a cyst of nut size with a fibrocalcareous wall containing a chocolate colored fluid. Microscopically it was a simple adenoma in part colloid in part made up of small cellular nests of embryonic type. There was no evidence of atypical carcinomatous proliferation.

CASE 73. Wölfler (73). A woman 57 years of age had severe headaches followed by the appearance of a tumor

of the left frontal bone. In one year it had reached goose egg size. Extirpation was followed by healing. The patient died during the same year. Microscopically the tissue was typical goiter intercalated adenoma of thyroid gland with no evidence of malignancy. (The accompanying drawings show many solid cell nests.)

In the left half of the thyroid a hard tumor which reached fist size appeared before the thyroid tumor. There was occasional pain on swallowing. (The menses stopped simultaneously with the appearance of the thyroid tumor followed by periods of hematuria at intervals of 6 weeks.)

*No microscopic examination. No autopsy.*

CASE 74. Zadek (74). A man 56 years of age experienced pain and lameness following a fall. The X-ray showed a fractured area at the base of the femoral neck. Sixteen months later a pathological fracture occurred. A large cavity filled with reddish tissue was curetted out. Microscopically it was thyroid adenoma. Aberrant thyroid. Seventeen months later hemorrhage from the site of the fracture was followed by death.

Physical examination showed the thyroid to be normal. *No microscopic examination and no autopsy was made.*

CASE 75. Zahn (75). A woman 53 years of age had had left sided facial palsy and deafness 13 months previously. Eleven months later weakness coldness and formation of the lower extremities were followed by paralysis. There was anesthesia below the umbilicus. The Babinski reflex was present together with urinary incontinence emaciation and a sacral decubitus. There was a pulsating tumor at the level of the ninth rib to the right of the vertebral column. *Autopsy.* A nodular nut sized tumor of the temporal and occipital bones involved the middle ear the facial acoustic and hypoglossal nerves with pressure on the cerebellum. There were constriction of the left transverse sinus and direct extension of new growth into the jugular vein. Another tumor of the skull was found near the carotid canal. Kyphosis could be noted at the level of the seventh cervical vertebra. A soft fluctuating tumor the size of a chicken egg involved the eighth to the tenth thoracic vertebrae entered the spinal canal and compressed the spinal cord. Near the costochondral junction of the third right rib was an irregular tumor. There were similar tumors at the costochondral junctions of the second and third left ribs. Microscopically all tumor showed similar architecture. At the periphery was an acellular connective tissue capsule. Small alveoli were filled with cells or a homogeneous mass and surrounded by round cubical and cylindrical cells. Regressive metamorphosis was not seen.

The thyroid gland was normal in gross appearance. The left lobe was somewhat enlarged. The right lobe contained cherry sized adenomata. Microscopically both lobes showed simple hypertrophy with colloid degeneration. The nodules were simple adenomata.

CASE 76 and 77. Zappaloni (76) reports 2 cases of osseous thyroid tumor. There were no signs of goiter or of thyroid cancer. *No autopsy was performed and no histological examination made.*

## CONCLUSIONS

1. The original observations of supposed metastases of normal thyroid tissue by Cohnheim and by Morris have been widely quoted and have influenced many others to report somewhat similar cases.

2. Cohnheim's case report of "Simple Colloid Goiter with Metastasis" contains

One half year later (June 1901) there was a recurrence the size of a chicken's egg in the left frontal bone. Simultaneously there appeared an apple sized tumor in the right temporal bone and a walnut sized tumor at the right sternoclavicular junction. The patient was markedly emaciated. Death followed the removal of the temporal metastasis. Incomplete autopsy (upper sternum, left clavicle, trachea, thyroid gland and frontal recurrence) showed microscopically a recurrence and the sternoclavicular nodule showed normal thyroid tissue.

The right lobe of the thyroid gland became enlarged as the recurrence and temporal tumor appeared. On section of the right thyroid a spherical nodule was found encapsulated. This nodule was recognized as the primary tumor anatomically. Histologically it resembled thyroid tissue. *No complete autopsy.*

CASE 59. Patel (59). A woman 65 years of age had a tumor of the left frontal bone (orbital margin) of 4 months duration. It was expansile synchronous with the pulse. At extirpation it was found to rest on the meninges and to perforate completely the frontal bone. Microscopically there were areas reproducing normal thyroid and other areas showing the character of a thyroid carcinoma of high malignancy. There was a recurrence 8 months later.

For 30 years there had been a tumefaction of the thyroid gland with no recent augmented growth and no signs of malignancy. The tumor was uniformly hard, mobile and painless. *No histological examination was made and no autopsy performed.*

CASE 60. Forcic (60). A woman 46 years of age had a slowly developing tumor involving the inner third of the clavicle, sternoclavicular articulation and manubrium sterni with pains in the left arm. Extirpation revealed a grossly irregular spherical mass with a firm gray peripheral zone and a soft central zone. Microscopically follicles were surrounded by cubical and columnar cells and contained homogeneous colloid. Some areas showed the structure of adenoma others were carcinomatous. Paraplegia was followed by death. There was a metastasis also to the seventh dorsal vertebra.

In the thyroid gland was a walnut sized tumor firm, painless, not adherent to the skin. The patient experienced no difficulties in respiration or deglutition. *No microscopic examination was made and no autopsy performed.*

CASE 61. Poser (61). A woman 45 years of age soon after thyroidectomy 6 years before examination developed weakness of the left leg followed by paresthesia. There was a feeling of pressure in the abdomen with pains in the right leg. A soft irregular swelling appeared at the right posterior iliac space. At operation a soft grayish red tissue was found extending from the lumbar vertebrae. Paresthesia disappeared only to reappear a few days later. Six months later a hand size pulsating tumor appeared in the sacral region with rapid recent growth. The patient was bedridden and cachectic. Microscopically the lumbar tumor showed long parallel strands with colloid deposit and large vessels filled with colloid and surrounded by flattened epithelial cells.

Twenty years previously a small goiter had developed and had remained uniform for 14 years after which it grew rapidly and caused marked difficulty in swallowing. At operation all of it was removed except a portion of the left lobe. Microscopically it was a parenchymatous colloid goiter. At the time the case was reported the thyroid contained a nodule the size of a walnut in the midline with no fixation to the skin or the underlying tissues.

CASE 62. Radley and Dugan (62). The patient was a man 46 years of age. A small nodule had appeared in the right clavicle 6 months previously and grew to orange size

was smooth tense and showed visible pulsation. A reddish brown vascular soft tumor was excised. Histologically it was a secondary thyroid carcinoma with both solid and tubular acini. Tests for iodine were negative.

Two years before a small adenoma had been shelled out of the thyroid isthmus. It was normal in size, consistency and mobility with no evidence of malignancy. *No histological examination. No autopsy.*

CASE 63. Regensburger (63). A woman 55 years of age had had a painful swelling in the left upper arm 2 years previously which had gradually increased to the size of a man's fist. In the infraclavicular fossa were 2 hard glands of hazel nut size. The patient showed marked cachexia. A diagnosis of sarcoma was made. The upper third of the humerus was resected and the infraclavicular glands removed. Healing resulted. The tumor of the humerus 9 by 6 centimeters infiltrated the bone irregularly. The lymph nodes were replaced by whitish growth. Microscopical examination showed bone tumor and lymph glands. There were large epithelial cell masses some forming longitudinal rows. Many acini showed typical thyroid structure. Many papillae were covered with large cylindrical cells. The lymph nodes were almost entirely analysis showed no iodine.

In the middle lobe of the thyroid was a hard tumor the size of a prune. *No microscopic examination. No autopsy.*

CASE 64. Reinhardt (64). A woman 51 years of age for 6 months had had pains in the right scapula radiating to the left arm. Later sudden paralysis of the lower extremities appeared. Laminectomy of the second to the fourth thoracic vertebrae was done. On both sides of the midline were hazel nut sized tumors of the vertebrae. Extirpation resulted in death during operation. Microscopically the tissue was simple benign parenchymatous goiter.

The patient had a large goiter with no growth for years. Clinically it was not malignant. *No microscopic examination. No autopsy.*

CASE 65. Riedel (65). The patient was a woman 40 years of age. Thyroid tissue was removed from the jaw with recurrence 10 years later.

There was no growth of the thyroid gland at the time of operation or during the 10-year interval. *No microscopic examination. No autopsy.*

CASE 66. Riedel and Haackel (66). A woman aged 48 had a deep-seated rapidly developing tumor mass in the midline of the maxilla. Hemiresection of the jaw was done. Microscopically the tissue was typical thyroid. There was no recurrence 4 years later.

The patient had a large goiter at the same time which had been present for 20 years. *No microscopic examination. No autopsy.*

CASE 67. Runge (67). A woman 41 years of age 3½ years before had felt a sudden crack in the back of the neck accompanied by stinging pain. Rotation was limited the head fell to one side and flexion and extension were later limited. Active motion of the head was impossible. Simultaneously the right arm and leg became paralyzed. Later the left arm became paralyzed. A diagnosis was made of compression myelitis due to cancer or tumor of the epistrophus. The patient died in the seventh month of pregnancy. Successful postmortem and cesarean section was done. *No autopsy.* There was a reddish tumor of the occiput around the foramen magnum, atlas and epistrophus. The main mass in the spinal canal originated in the epistrophus and infiltrated the muscle. Microscopically (von Recklinghausen) nests and strands of cells were spherically disposed in alveoli. Many were colloid-containing with a single layer of flattened cells as in thyroid gland. (This was regarded by Cohnheim as similar to his case.)

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abundant evidence of primary carcinoma of the thyroid gland

3 In Morris's case there was no examination of the thyroid gland

4 In most of the collected cases the diagnosis of "benign metastasizing goiter" was based upon the clinically benign appearance of the goiter and upon the benign microscopic appearance of extirpated metastases

5 Metastases of thyroid carcinomata are subject to great variability in microscopic appearance and may assume the structure of normal thyroid tissue, benign thyroid adenoma or simple colloid goiter. Such secondary growths may function as does normal thyroid tissue

6 In but 29 of the 77 similar cases which have been collected from the literature was there microscopic examination of the thyroid gland and in many of these were described areas of undoubted carcinoma. Autopsy was done in but 33 per cent of the previously reported cases

7 The belief of some writers that these distant metastases represent aberrant thyroid tissue has no basis in fact

8 The metastases in the cases of so called benign metastasizing goiters show the same striking predilection for bone that characterizes secondary growths of thyroid origin which show frank carcinomatous structure. The vertebral bodies and the cranial bones are most frequently involved. Pathological fractures of the humerus and femur are common. The osseous metastases frequently show fluctuations in size during menstruation and pregnancy. Pulsation is likewise a common finding

9 Most of the thyroid metastases to bone were diagnosed clinically and roentgenographically as primary sarcomata. Metastatic new growth of thyroid, prostatic, breast, adrenal or renal origin should be considered in cases of skeletal new growth

10 In most instances the authors published the case reports shortly after they discovered the innocent microscopic appearance of the metastases without waiting to learn of the outcome

11 Two cases from the University of Michigan Hospital showed osseous metastases

of microscopically benign thyroid tissue associated with clinically negative goiters. One of the cases was reported soon after operation as an instance of metastasis of normal fetal thyroid tissue. Both patients subsequently showed clinical evidence of undoubted carcinoma of the thyroid gland and died within 18 months and 2 years respectively

12 Many cases are recorded in which the microscopical examination of tissue from the metastasis revealed normal thyroid structure while histological study of tissue from the thyroid gland showed areas of undoubted carcinoma

13 There is an abundance of evidence to indicate that there is no such entity as the benign metastasizing goiter and that the use of this confusing term should be abandoned

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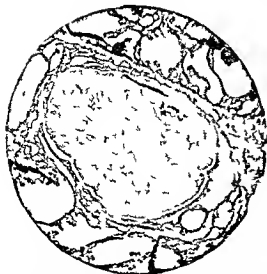


Fig. 1. Microscopic section of a parathyroid gland embedded in a hyperplastic thyroid which has been converted to involution by iodine

The lobes should be carefully sponged without roughness immediately after they are removed. The parathyroids may be distinguished by their characteristic brownish color in moderate contrast to the reddish color of thyroid tissue by the fact that by gently moving them from side to side they may be demonstrated as attached to but not a part of the thyroid and by their fairly typical bean shape with a thickness of only half their length or width.

When they are demonstrated they are gently cut from the gland care being taken to see that little or no thyroid tissue is taken with the parathyroids and that the bodies are not picked up by instruments. They should be so cut away from the gland with scissors that the gland rests upon the blades of the scissors until it is ready for transplantation.

After we have made sure that there is no attached thyroid tissue a hole is made in the belly of the left sternomastoid by inserting the points of a pair of blunt scissors deeply into the muscle and gently spreading them apart. If the cavity thus made is dry the parathyroid is placed within it and the opening closed with two or three stitches of plain

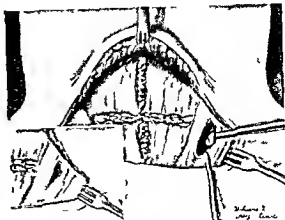


Fig. 2. Showing method of transplanting parathyroid into sternomastoid muscle. Inset showing closure of muscle over transplanted gland.

No catgut. It is essential that the cavity be dry as shown by Marine and should a small vessel be ruptured on spreading the scissors apart they should be inserted at another location and a dry cavity obtained.

#### CONCLUSIONS

Since parathyroids will occasionally be removed at operation and identified in the laboratory they should be carefully searched for on the specimen following operation and if found transplanted.

The belly of the sternomastoid is the most convenient place into which to transplant them and care should be taken to see that the cavity into which they are transplanted is dry.

Since this article was sent for publication twenty six additional possible parathyroids have been transplanted and a plan of taking a small section from each transplant has been instituted. This is sent to the laboratory for report as to whether or not the transplant actually is or is not a parathyroid. It is of interest to note that out of twenty five bodies transplanted as possible parathyroids four have actually been proven by histological examination to have been parathyroids two were reported possible parathyroids and nineteen were not parathyroids but probably lymph glands.

This note is appended to demonstrate the difficulty of recognizing parathyroids macroscopically and the need of microscopic report to determine in which cases parathyroids have actually been transplanted.



## THE TRANSPLANTATION OF PARATHYROIDS IN PARTIAL THYROIDECTOMY

BY FRANK H. LAHEY, MD, FACS, BOSTON, MASSACHUSETTS

THE careful search for parathyroid bodies on the surgical specimens of thyroid lobes removed during our operative thyroid procedures has resulted in the not infrequent discovery of these bodies particularly in the region of the upper pole of the gland. We have found them on the posterior surface of the gland on the internal surface close to the point where the upper prolongation of the gland rests against the trachea and on the external surface where the pole is in contact with the internal jugular vein. Dr. R. B. Cattell working on the material from our clinic has demonstrated several parathyroid bodies within the substance of the gland in the upper pole and entirely surrounded by thyroid tissue.

It is of course obvious from the section shown in Figure 1 that it would be impossible to remove the lobe in such a case as this without removing the parathyroid also.

Up to within the last year we have been accustomed to look with complacency on the occasional appearance of a parathyroid body on a surgical specimen and to feel that since it was practically impossible not to remove an occasional upper parathyroid body and that since we have had but 2 cases of tetany in 3,000 thyroid operations there was no occasion to be disturbed by their appearance now and then upon a surgical specimen. We felt that our plan of subtotal thyroidectomy was such as to insure the preservation of one or both of the inferior parathyroids and with the incidence of complete tetany as low as stated above have paid little attention to these specimens of parathyroid except to study their histological structure.

We have within the last 2 years come to believe that the occasional discovery of parathyroids on the specimen should not be made in the laboratory but at the operation by carefully examining the thyroid lobes as soon as they are removed and that if parathyroid bodies are discovered they should immediately

be transplanted with the possibility of their continuing to live function and supply their valuable secretion so necessary to the organism should there be a deficiency of that substance.

Dr. R. L. Mason of this clinic has shown conclusively that while gross tetany appears but rarely following subtotal thyroidectomy, many of the signs of partial tetany may be elicited following this operative procedure such as the accoucheur's hand following the application of blood pressure cuff, Chvostek's sign and lowering of the blood calcium. The demonstration of these facts indicates to us the narrow margin of safety which probably exists postoperatively between a sufficient and an insufficient amount of secreting parathyroid tissue available for the organism.

Since parathyroids have been successfully transplanted in animals since the glands are entirely wasted otherwise and since every thyroid operator is or should be familiar with the appearance and location of the parathyroid bodies we urge the immediate search for parathyroids at the operating table and their immediate transplantation when they are found.

We have in the last 6 months found and transplanted parathyroids in 10 cases. We have had no opportunity to demonstrate whether or not they have been successfully grafted but have kept careful records as to the cases and the location of the grafts in case the opportunity should arise later to demonstrate their persistence or non-persistence in their transplanted state.

The transplantation is always made into the belly of the left sternomastoid muscle so that there shall never be any question regarding the muscle into which the lobes were transplanted if an opportunity presents itself for examining them at a later time.

The technique of transplantation is extremely simple and requires little further elucidation than is evident in the illustrations.

destroyed in the liver tissue resulting in a chromatolysis and vacuolization of the liver cells with the formation of free pigment. Coincidentally there is an invasion of round cells with the ultimate result of a small area of necrosis later replaced by fibrous tissue. This probably explains the recovery in such cases as Case 12 of this series.

In several places in the literature on this subject pylephlebitis is spoken of as synonymous with pyæmic abscesses of the liver. The writer takes exception to this terminology. It may be true in cases of multiple abscesses but not true in single abscesses. In other words we may have a localized pylephlebitis or a diffuse pylephlebitis without a liver abscess (Case 4) or we may have either with a single or with multiple abscesses or there may be no demonstrable pylephlebitis yet a liver abscess may be present (Case 7). The mesenteric veins as well as the omental veins must be considered as carriers of infection into the liver. The omentum is peculiar in its vascularity containing many converging veins of great length with their walls easily wounded. Eiselsberg demonstrated how rapidly these veins are thrombosed after operation, and Wilkie also showed the ease with which injury and thrombosis of the portal vein occurred. By mere ligation of the omental veins be produced punctiform hemorrhage in the stomach in 30 per cent of the cases and hemorrhagic infarcts in the liver in 50 per cent. If aseptic thrombi in omental veins showed these pre-eminent tendencies toward upper abdominal embolism how much greater must be this embolic tendency in a septic thrombosis as occurs in acute appendicitis cases. These facts may explain two things: first why liver abscesses sometimes occur without mesenteric phlebitis and second why the draining of the omental veins into the gastric vein which in turn drains mostly into the left lobe accounts for left lobe involvement.

#### INCIDENCE

Schlesinger states that Stullman in a study of 1,748 cases of appendicitis found that complications occurred in 7 per cent and of these only 2 (0.14 per cent) were cases of liver abscess. Rendle Short according to Barlow

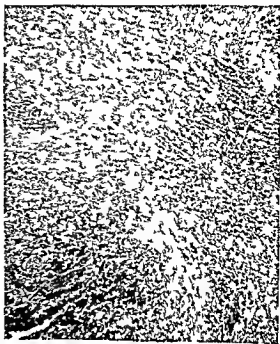


Fig. 1. Case 1. Section of liver tissue removed at autopsy showing small abscesses grouped around small portal radicles.

found that suppurative phlebitis occurred in 0.4 per cent in a series of 2,714 cases. Gerster reported in a series of 1,189 cases of appendicitis an incidence of 9 cases of pylephlebitis. Krognus, quoted by Babler, had only 2 in 1,000 cases of appendicitis. He also states that Bell had 8 cases in a series of 1,726 appendicitis cases. Schlesinger in 1924 collected records of all such cases and found but 23 reported of which 20 patients were known to have recovered by operative treatment. A careful examination of the literature discloses at least 30 more cases with a reported recovery of only 7. This makes the series total 53 cases with 27 deaths (59 per cent mortality). It seems rather difficult to explain 20 recoveries in the 23 cases collected by Gerster as compared with only 7 recoveries in the 30 cases collected in this paper. The total number of cases that have been found reported to date is 53 (see bibliography). It is true that the diagnosis in some of these cases was not confirmed by operation or autopsy. Furthermore in a few instances the diagnosis was that of pylephlebitis with the assumption

# PYLEPHLEBITIS AND LIVER ABSCESS FOLLOWING APPENDICITIS

By E. L. ELIASOV, A. B. M. D. F. A. C. S. S. C. D. PHILADELPHIA

**P**YLEPHLEBITIS and abscess of the liver have come to be regarded by many writers as synonymous. Liver abscess may arise through four channels: the portal veins, the hepatic artery, the bile ducts and possibly, although in no case has this been demonstrated through the lymphatics. When the hepatic artery is the portal of entry the abscesses are small and multiple; the patient dying from the original blood stream infection when the bile ducts carry the infection the abscesses are distributed accordingly and pus is found in the ducts. The lymphatics as carriers are probably concerned in diffuse peritonitis cases. It is only when the infection travels via the portal veins that we can have both pylephlebitis and hepatic abscesses; even then the two conditions are not always associated as is subsequently shown by one of the cases reported in this paper.

By far the most important single cause of this condition is suppurative appendicitis. Langdon Brown collected 46 cases and found that appendicitis was responsible in 42 per cent. It is however true that in some countries dysentery is the most frequent cause of liver abscesses but not of pylephlebitis. Infection in the portal system due to appendicitis may be limited to the vessels of the meso-appendix, the caecal branches of the colica dextra or it may be more extensive and result in a widespread thrombophlebitis of the suppurative type with a single or more often multiple hepatic abscesses. If the abscesses are single infection usually involves the right side of the right lobe and probably is due directly to a septic embolus from one of the appendiceal vessels (Cases 2, 4, 7, 13).

Serège (Bruggeman) seems to have proven by means of Chinese ink injections that there are two currents of blood in each portal vein: one originating from the superior mesenteric vein going to the right lobe, the other coming from the inferior mesenteric veins being distributed chiefly to the left lobe. This may account for the greater frequency of right

lobe solitary abscesses although cases are reported showing left lobe involvement. In the series reported in the present article however left lobe involvement was associated only with multiple abscesses. Liver abscesses following a pylephlebitis are usually multiple and are distributed in the immediate vicinity of the portal system. When there is a suppurative inflammation about the appendix a local purulent thrombophlebitis may occur followed by a loosening of the infected clot with the formation of multiple infective emboli in the smaller hepatic branches of the portal vein. Each embolus of this nature may and usually does become the center of a small abscess and such abscesses may be so abundant as to be strung along the course of a group of vessel branches much like a bunch of grapes (Fig. 1). Surrounding the abscesses there is intense congestion as a result of the toxæmia and circulatory disturbances; a parenchymatous change occurs in the entire liver varying anywhere from ordinary cloudy swelling, central necrosis and fatty degeneration to a picture very closely simulating acute yellow atrophy (Case 5).

Koerte is quoted as believing that the suppurative process usually travels upward through the retrocecal tissues. This was not the case in any of the cases reported in this article. It is true that often (10 of the 14 cases) there is evidence of a panetel and retro-pentoneal cellulitis shown by oedema but in none of the reported cases was any pus collection found in the retrocecal areas. Subdiaphragmatic abscesses occur after suppurative appendicitis but they are probably secondary to a liver abscess that has broken through into this area. This was found to be the case in 2 of the cases here reported (Cases 4 and 13). Occasionally a chronic appendicitis may be responsible for a liver abscess as is illustrated in all probability although not proven by Case 1 of this paper. In this connection Heyd states that bacteria carried to the liver do not always undergo proliferation but are



Fig 3 Case 4 Before drainage of abscess Right diaphragm high and fixed Left diaphragm restricted in movement Shadows at each base



Fig 4 Case 4 Showing hydropneumothorax right side after rib resection and drainage of liver abscess of right lobe

polymorphonuclear increase In the pre operative counts the highest was 9000 and the lowest was 10200 An interesting finding was observed in the course of Case 7 Widal's haemoclastic test was positive for liver tissue destruction The leucocytes dropped from 10600 to 10600 These high counts persist until relief is given by drainage of the liver focus

**Pain** is not a constant symptom as it is absent or at least not mentioned in many of the case reports reviewed in the literature of the last 10 years However when it is present it is located in the right upper quadrant is dull and at times pleuritic at other times it is a dull ache under the shoulder blade The presence or absence of pain cannot be regarded as of paramount importance in the diagnosis It was complained of by 5 patients in this series Multiple abscesses were present in all 5 cases and in 3 a pathological condition in the chest was evidenced by friction effusion and an X ray shadow in the lower right chest

**Icterus** Jaundice is almost invariably present and appears early in the course of the infection In fact its appearance in the pa-

tient early in the attack of appendicitis will often lead to the erroneous diagnosis of a gall bladder disease the acute appendicitis being entirely overlooked (Case 5) At times a slight icteroid tinge to the sclerae may even precede the postoperative appearance of the warning chill On the other hand jaundice may be so slight as to escape the examiner's notice entirely even though the urobilin appears in the urine

**Tenderness** This finding is always present and can be elicited if the hunt is sufficiently careful It is found over the right lobe of the liver as a rule and can be produced by the fist percussion of Murphy If the abscess is single and situated as it frequently is on the under surface near the anterior border of the liver the tenderness can be found by simple palpation Finger percussion above the tenth rib in the midaxillary line produced pain and tenderness in 11 of the 12 abscess cases there being no liver tenderness in the 2 cases of pylephlebitis without demonstrable abscesses

**Edema** In 11 of the cases a localized firm or boggy edema was noticed over the region





Fig. 3 Case 4 Before drainage of abscess. Right diaphragm high and fixed. Left diaphragm restricted in movement. Shadows at each base.



Fig. 4 Case 4 Showing hydropneumothorax right side after rib resection and drainage of liver abscess of right lobe.

polymorphonuclear increase. In the pre-operative counts the highest was 29,000 and the lowest was 10,200. An interesting finding was observed in the course of Case 7. Widal's hemoclastic test was positive for liver tissue destruction. The leucocytes dropped from 19,600 to 10,600. These high counts persist until relief is given by drainage of the liver focus.

**Pain** is not a constant symptom as it is absent or at least not mentioned in many of the case reports reviewed in the literature of the last 10 years. However, when it is present it is located in the right upper quadrant, is dull and at times pleuritic. At other times it is a dull ache under the shoulder blade. The presence or absence of pain cannot be regarded as of paramount importance in the diagnosis. It was complained of by 5 patients in this series. Multiple abscesses were present in all 5 cases and in 3 a pathological condition in the chest was evidenced by friction effusion and an X-ray shadow in the lower right chest.

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Fig. 5 Case 4 Six weeks after drainage of subdiaphragmatic and liver abscess. Right diaphragm high flat and fixed. Considerable fibrosis at right base.

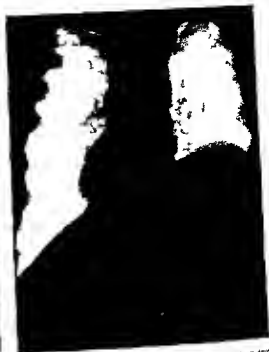


Fig. 6 Case 6 Roentgenogram showing condition two and one half months after an attack of appendicitis. High right diaphragm with fixation.

of the lower ribs in the midaxillary line with the characteristics of a lymph rather than a vascular edema. Compared with vascular edema it pitted with more difficulty and the depression lasted longer. Again when the tissues in both flanks were picked up between the fingers and thumbs of each hand the one of its affected (usually the right) side were found thicker than normal. This, *as I have come to consider of enough significance to warrant exploration when the symptoms previously mentioned are present*. In late cases this peculiar doughy condition affects the anterior abdominal wall and is frequently accompanied by an increased prominence of the veins over the lower chest and upper abdomen. This dilated condition was noted in 9 cases.

**Nausea and vomiting.** In 5 of the series vomiting occurred but it was not a very prominent feature and in most cases occurred only occasionally and then only after taking food. Nausea however was bitterly complained of by some. Neither nausea nor vomiting was dependent upon the number or position

tion of the abscess nor could they be used as an index for prognosis.

**Ascites.** In only 1 case and that of a severe pyelophlebitis with multiple liver abscesses was a note found of any undue fluid in the abdomen.

**Lassitude anorexia emaciation.** Without exception the entire series showed these three conditions in a marked degree. Almost invariably the patients would state that they felt all right but were "too tired to sleep." Food was distinctly distasteful and could be administered only under protest. Rapid loss of weight was a marked feature also, varying in its degree with the amount of liver disease.

**Rx-ray findings.** Roentgenograms and fluoroscopic examinations were made in 10 cases. Negative reports were returned in only 2. The other 8 cases were all reported by Dr. Pancoast as showing elevation of the right side of the diaphragm and in some instances restriction of movement on that same side. In 3 of the series there was also a shadow in the lower right chest interpreted as fluid. This

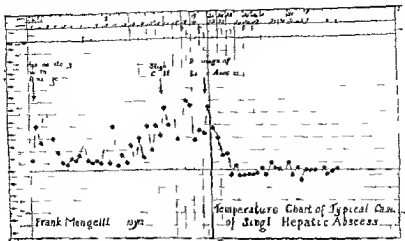


Fig. 7. Case Chart showing typical temperature curve of patient with single hepatic abscess

shadow appeared only in those cases in which the abscess or abscesses affected the upper surface of the liver

These X-ray findings are extremely interesting as they seem to point to the fact that pus in the liver will give much the same phenomena as will subdiaphragmatic pus. In Cases 1, 4, and 13 there was an abscess between the diaphragm and the liver but it was a result of a rupture of a liver abscess into this space as shown at operation the condition being then one of the hourglass type of abscess.

It may be stated here that in practically all of these cases the clinical diagnosis at first was a basal pneumonia or a subdiaphragmatic abscess. Before operation however in each instance the proper diagnosis of liver abscess was made.

**Urinalysis.** Urobilin was found in the urine in 5 of the cases. It is not mentioned in the other records.

**Organisms.** Cultures were made in 8 cases of the series. In 4 cases the organism was streptococcus in 3 staphylococcus and in 1 bacillus mucosus in 1 the culture was sterile. In only 1 was a colon bacillus found. Blood cultures were sterile in the entire group.

#### NUMBER OF ABSCESES

In 7 of the 12 cases (58 per cent) only a single abscess was found. These figures are very interesting in view of the fact that they

agree with the facts as obtained from foreign literature but are not in accord with the statements of many American surgeons some of whom state that the fact that the abscess is single and the patient recovers, proves it not a liver abscess but a subdiaphragmatic collection. Solitary abscesses were all in the right lobe most often in the lateral aspect of the dome. One only was on the under surface.

#### AGE OF PATIENTS

The oldest patient was 67 years of age the youngest one with abscess was 13 years old while the youngest one with pylephlebitis was but 7 years of age. As would be expected the occurrence is more frequent in the period of appendicitis prevalence namely in young adult life. Only 2 patients were beyond 45 years of age.

#### MORTALITY

Seven of the 14 patients lived (50 per cent). This is not as high a recovery rate as that quoted earlier in this article from the cases collected by Schlesinger namely, 20 recoveries in 23 cases. However, it more nearly approximates the mortality rate (59 per cent) of the entire number of cases 53 collected by the writer from the literature at the time of writing. Adding the present series of 14 cases with 7 deaths we have an average mortality of 54.5 per cent. This gives one pause, as many





Fig. 8 Case 7 Koenigsmannogram of chest 18 days after appendectomy. Shadow at right base with high restricted right diaphragm. Slight pleural collection right lateral chest wall.



Fig. 9 Case 7 Roentgenogram showing liver abscess cavity outlined with bismuth subcarbonate. This picture was made one week after the abscess had been drained.

textbooks state that pyelophlebitis is practically invariably fatal.

If a careful survey of the reported series be made two very startling facts are brought to light. The first of these is that in every case a provisional diagnosis and often a retained diagnosis of a right basal pneumonia was made. This was based on the physical findings of a compressed lower lobe together with effusion in some instances. The X-ray disproved the pneumonia diagnosis in each case. Therefore in looking over the cases as collected and noting the increasing frequency of diagnosis 14 cases in 3 years in the writer's service as compared to a previous total of 53 in the literature one cannot help but believe that in many of these cases a diagnosis of septic pneumonia was made. The X-ray has made this error in diagnosis impossible and has shown the condition as it really exists.

The second startling fact brought out is that a positive operative diagnosis was made very tardily in all cases. In the 3 cases that developed after appendectomy by the writer the diagnosis was made of pyelophlebitis and liver abscess in 14, 19 and 20 days. In the cases coming to the hospital with the condition already present, the histories proved the dis-

ease to have been present for periods varying from 2 weeks to 11 months, 3 cases being respectively of 8, 10 and 11 months duration, a sad commentary on our diagnostic ability.

#### TREATMENT

Operation was performed in all cases. The 7 solitary abscesses were approached through the chest. Under local anesthesia the abscess was found with the needle. The rib usually the tenth in the midaxillary line was resected, the needle still in place. The diaphragm was sutured in some instances and in others packing was placed against the pleura. The needle was withdrawn and the patient sent back to bed to be returned the following day. An exploring needle was again inserted and when pus was located the actual cautery was slid along the needle until an opening was burned into the abscess cavity. This was then drained with a tube.

In the remaining 4 cases laparotomy was performed. In Case 1, 7 or 8 operations were performed and as many abscesses drained, including an enormous subdiaphragmatic collection.

CASE 1. A. H., a male 22 years of age gave a history of an attack of appendicitis 10 months before

his admission to the hospital. A month later he began to have chills fever and epigastric pain. On several occasions he had sharp attacks of pain with vomiting followed by great weakness. On admission he was very much emaciated. His chest showed a few moist râles at the base of the lungs. There was a firm bulging mass in the epigastrium which was somewhat tender and seemed to be located in the liver. He had no jaundice and his urine did not show urobilin. The X ray examination showed high left diaphragm. The temperature was 101-97 degrees F pulse 122 respiration 28 white blood cells 13,000. Blood culture showed no growth. (See temperature chart Fig 2.) A diagnosis of liver abscess of the left lobe was made. Two days later the abdomen was opened through a right rectus incision and the liver was found adherent to the parietal peritoneum. Its surface was studded with small abscesses four of which were opened with the cautery and a rubber tube drain inserted. The septic fever continued with little change in the general condition in spite of a blood transfusion and other measures. Two weeks later needles thrust through the previous wound into the liver located 3 small abscesses which were incised by cautery. After 4 days because of left sided pain and an X ray showing a high left diaphragm an attempt was made to locate pus by the insertion of an exploring needle in the tenth interspace at the posterior axillary line on the left side. The pus was found and a portion of the tenth rib removed preparatory to a transdiaphragmatic drainage. The pleura was found normally thin and transparent however so the costophrenic angle was obliterated by sewing the lateral and diaphragmatic pleura together in an elliptical row of sutures through which the diaphragm was opened and the abscess drained 3 days later. About 4 ounces of yellow pus were evacuated. After the operation the patient remained more comfortable. The pain was less intense and a light irritating cough disappeared. The temperature curve continued to be of the septic type however. A week after the last operation purpuric spots developed over the chest and the patient died 5 days later with asthmatic symptoms. At autopsy the liver was found dotted with small abscesses particularly over the left lobe and the cut surface showed branched abscesses extending along the portal vein (Fig 1).

**CASE 2** J. B. a male 45 years of age was admitted to the University Hospital with a history of an acute appendicitis of 10 hours duration. At operation a gangrenous appendix was removed and drainage instituted. It was noted that the cecum and the meso appendix were markedly red and edematous. Eleven days after a rather slow but apparently normal postoperative convalescence the patient had a chill with an elevation of temperature. This was the first of a series of chills. The temperature curve was of the septic type. The leukocytes went from 12,000 to 17,000 and slight jaundice of the sclera and face developed. Anorexia nausea and



Fig 10. Case 7. Photograph of patient 1 year after drainage of liver abscess showing scars of appendectomy wound and of liver abscess incision.

vomiting became prominent symptoms so that proctoclysis had to be given. Two blood cultures showed no growth. A fluoroscopic examination of the chest was negative. The abdominal wall especially the right upper quadrant gave a doughy sensation to the examining fingers. Small veins were visible in the same area. The liver edge was palpable soft and not tender. Based on these findings a diagnosis was made of pylephlebitis with liver abscess 20 days after appendectomy. A medical consultant suggested the possibility of an acute endocarditis but the negative blood culture lack of cardiac signs petechia blood in urine and other embolic phenomena made the diagnosis seem probably incorrect. A week later the abdomen was opened through a right rectus incision. From the right iliac fossa extending upward toward the pylorus and thence along the gastrohepatic omentum was found considerable induration and edema. The mesentery was thick and somewhat stiff. The liver was enlarged and presented a chestnut sized nodule on its under surface just to the right of the gall bladder. A needle inserted into this area obtained pus. After the rest of the abdomen had been thoroughly packed off the abscess was opened with a cautery and drained with a rubber tube and several cigarette drains. The pus culture showed streptococcus mitis (Hofmann). The patient was in a state of grave toxemia immediately

after the operation but he rallied somewhat after a blood transfusion and the following day his record showed a temperature of 99.2 degrees with a pulse of 110. Two days after the operation a left sided parotitis developed and a day later the other side became involved. The abdominal signs gradually improved but he died 6 days after the operation of profound toxemia. Necropsy was refused.

CASE 3 J F a male 7 years of age was admitted to the Pediatric Service of the University Hospital after 8 weeks of illness at home. His sickness which began with abdominal pain vomiting and fever continued changing to a hectic type of fever with anorexia abdominal pain and distention. On admission the important findings were emaciation prominent subcutaneous veins in a distended abdomen and two doughy masses one in each lower abdominal quadrant. The white blood cells numbered 15,000 temperature was 99.6-97.6 degrees pulse 116 respiration 28. A tentative diagnosis of tuberculous enteritis was made and the patient was treated for some time with this diagnosis in mind. Nine weeks after admission he began to have recurrent attacks of higher fever and slight jaundice appeared with some vomiting and a leucocytosis of 20,000. The patient was then seen by the writer and a diagnosis was made of *pylephlebitis* following a perforative appendicitis and peritonitis which had been his first illness. Twelve weeks after admission a laparotomy was done through a right rectus incision. All abdominal organs were matted together with dense adhesions which were separated with difficulty. Back of the cecum was a cavity lined with granulating tissue evidently an old abscess cavity. The appendiceal stump was hidden by dense new connective tissue. Drainage was instituted through a stab wound at McBurney's point after several adhesions had been released. The postoperative course was without incident. The temperature reached the normal line on the fourth day after operation and it showed little variation until his discharge 13 days later. He is now in perfect health and without symptoms.

CASE 4 J L a male 34 years of age was operated on for acute appendicitis 2 years before his admission to the University Hospital. Since that time he had had several attacks of sudden severe abdominal pain lasting for several days. On one occasion a large amount of pus was drained out through the site of the previous incision. The last attack began 7 days before and continued until his admission. He had a high remittent fever with several attacks of right sided pain but no nausea or vomiting. A lower right lobar pneumonia developed for which he was treated in the medical wards for 6 weeks. During this time there developed signs of fluid in each base especially the right (Fig. 3). Attempts to drain this fluid were only moderately successful and the symptoms remained. The temperature ranged from 97 degrees F in the morning to 102.1 in the evening with frequent chills and sweats. He had some pain in the lower right chest

on deep respiration and the skin in this area was thick and tough and contained some dilated veins. He was markedly emaciated. White blood cell were 11,800 and the urine showed urobilin. A thoracentesis revealed pus. Under local anæsthesia a piece of the ninth rib was resected and a needle inserted into the pleural cavity. Clear fluid was obtained. When the needle was directed through the diaphragm however thick foul pus followed the plunger. The needle track was enlarged and an abscess cavity found in the right dome of the liver. This was drained and packed. The patient did not seem to recover as rapidly as we had expected and a week after operation the roentgenogram was as shown in Figure 4. One day later a needle inserted in the eighth interspace located a pocket of thick greenish pus which proved to be a subdiaphragmatic collection easily reached by the finger through the first wound. He rapidly recovered and was discharged with a dry wound. Figure 5 shows the condition on the day before his discharge 6 weeks after the abscess was drained.

CASE 5 A R a male 42 years of age was admitted to the Howard Hospital after 12 days of right abdominal pain vomiting fever jaundice and diarrhoea. On examination a mass was found in the lower right abdomen which proved to be an appendiceal abscess. The remnants of a gangrenous appendix were removed and drainage instituted. The third day after the operation he had a slight chill with subsequent rise in temperature. Two days later active hemorrhage began from the depths of the wound which was controlled by packing. The patient continued to have chill with a high remittent fever the temperature range being 105-98 degrees F. The blood culture was negative. White blood cells were 28,600. The urine showed hile pigments. On examination the liver was found somewhat enlarged and tender the skin was thick over it and the subcutaneous veins were dilated. There was some demonstrable fluid in the abdomen. The right diaphragm was found high and somewhat restricted in movement. The appetite was poor with frequent nausea and occasional vomiting. He continued to grow weaker gradually in spite of blood transfusions. A roentgenogram taken 5 weeks after the operation showed a high right diaphragm although there was no restriction in its movement noted under the fluoroscope. A *pylephlebitis* with secondary liver abscess was diagnosed 3 weeks after the appendectomy but operation was delayed until the patient could be built up a little preparatory to a second operation. Finally 6 weeks after the former operation a right transverse incision was made under local anæsthesia about 5 centimeters above the umbilicus exposing a lemon sized abscess of the lower part of the right lobe of the liver. The liver was enlarged and tender. The abscess was evacuated and drained. Culture of the pus showed *staphylococcus aureus*. After operation the patient continued to run a septic temperature gradually growing weaker until his death 11 days later. A

necropsy showed marked edema of the mesentery and gastrohepatic omentum with almost occluding thrombosis of the portal vein. The liver was enlarged and studded with abscesses of varying sizes which extended along the portal radicles. Two of these abscesses had been drained.

CASE 6 N DeL. male 40 years of age had an attack of acute appendicitis which was treated at home by his family doctor. Two and a half months later he was taken with a grippy feeling, jaundice and dull pains in upper abdomen. He had no appetite, no nausea and no vomiting. He had occasional chills. On admission to the University of Pennsylvania Hospital he was found markedly emaciated and moderately jaundiced with rather marked rigidity of the upper recti and right upper quadrant. A tender mass was palpated in the epigastrium. The skin over the right upper abdomen was thick and several dilated veins were visible. The X-ray showed fixation of the right diaphragm and high position (Fig 6). White blood cells numbered 21,000. Urine contained bilirubin and urobilin. A liver abscess was suggested through diagnosis. At operation the liver was found enlarged and the gall bladder was tense. When the gall bladder was opened viscid bile was obtained followed by thick pus. A cholecystostomy was performed. The patient grew steadily worse after the operation in spite of the fact that the drainage was profuse and the liver reduced in size. The temperature progressively rose to 102.6 degrees and the pulse to 136 and he died in profound toxemia 1 week after operation. The necropsy showed a large liver abscess communicating with many smaller ones of the branching biliary type.

CASE 7 F M. male 13 years of age was admitted to the University of Pennsylvania Hospital after 2 days illness with diffuse peritonitis. An appendectomy was performed immediately and drainage instituted. The patient was wildly delirious with high fever for 3 days after operation but on the fourth day peristalsis returned and the temperature reached normal. Thirteen days after operation he was allowed out of bed in a chair for 20 minutes. While he was up the temperature rose to 101 degrees F. The fever persisted to the fifteenth post-operative day with daily morning remissions and evening rises with a slight chill or two (Fig 7). A lobar pneumonia was looked for but no definite chest signs could be discovered. The right diaphragm was fixed however there was a slight bulging of the lower intercostal spaces and some tenderness at about the tenth rib in the anterior axillary line. There were dilated veins over the lower lateral chest wall and a boggy, tough edema which pitted slightly on pressure. A diagnosis of pylephlebitis or liver abscess was made. Widal's hemoclastic crisis showed

Three days later an indefinite mass could be palpated in the region of the right lobe of the liver. Rigidity of the upper right abdominal wall could be demonstrated. The lower right chest showed no expansion impairment to percussion increased fremitus and no suppressed breath sounds. The roentgenogram of the chest is shown in Figure 8. He was operated on 21 days after the appendectomy. An exploring needle was introduced below the seventh rib in the anterior axillary line into the pleural cavity. No fluid was obtained. When it was introduced downward pus was found. A piece of the tenth rib was resected and a second needle inserted into the abscess cavity. The drainage tract was enlarged with a hemostat and later with the finger. The cavity occupied the upper part of the right lobe of the liver and was the size of a lemon. The pocket was packed with plain gauze. The temperature reached the normal line 2 days after operation and he rapidly gained strength. A week after the drainage of the abscess the cavity was filled with a 10 per cent suspension of bismuth subcarbonate in sterile paraffine oil and a roentgenogram was made (Fig 8). He was discharged before the sinus had closed which occurred about 4 weeks after the operation. He is now in excellent health (Fig 9).

CASE 8 C McG. male 20 years of age had severe lower right abdominal pain 10 days before admission to the hospital. The abdomen was tender and rigid. Gradually the pain grew less but shifted to the right upper abdomen. He had several slight chills and on admission his temperature was 102 degrees F, pulse 100, respiration 34. There was no jaundice and no tenderness over the liver. The leucocyte count was 26,300. A diagnosis of liver abscess was made. An exploratory laparotomy by another surgeon was performed through a right rectus incision. The liver was found enlarged but without any nodulation on its surface. No other pathological findings were reported and the wound was closed. The patient did fairly well for 2 days after operation. On the third day jaundice was noted, the white blood cells were 30,800 and he began to cough. The abdomen was markedly distended, the temperature averaged 102.5 degrees F and he had several chills. A blood culture showed no growth. On the sixth day the wound separated when it was dressed and a second operation was necessary to close the wound. Intravenous saline solution was given. Three days later he became delirious, the temperature continued of a high hectic type with occasional chills and sweats. He showed marked emaciation and would not eat. Signs of pulmonary consolidation developed, then of fluid at the right base. Death occurred 17 days after operation. At necropsy a gangrenous appendix was found. In duration of the mesentery extended upward toward the liver. The liver was enlarged, adherent and showed many abscesses, larger centrally than peripherally extending along the portal vein. Bloody fluid was found in each pleural cavity with consolidation and abscess formation of the left lung.

W B C

8 30 a m — 19,600 — before 180 c cm milk  
9 00 a m — 17,400 — 1/2 hr after milk  
10 00 a m — 13,300  
10 30 a m — 10,600

**CASE 9** M B a male 34 years of age was operated on for acute appendicitis 8 months before his admission to the hospital. After he had been at home for a short time he noticed some soreness in the right side of the abdomen with an occasional sharp pain especially on sneezing or coughing. On several occasions he became deeply jaundiced and continually suffered from nausea vomiting poor appetite and loss of weight. Examination showed the patient to be emaciated and somewhat jaundiced. The liver was enlarged and tender. The right upper abdomen was somewhat rigid. The temperature was 100.5 degrees F the pulse 104 respiration 24 urine negative white blood cells 10 200. At operation (Dr C H Frazier) the abdomen was opened through a right rectus incision. The liver presented a rounded mass in the right lobe about 5 centimeters from the lower border. An aspirating needle inserted in this area obtained pus. An inch of an overlying rib was resected and about 20 ounces of pus aspirated. The abscess cavity was packed with gauze and one rubber tube drain was inserted. Three pieces of gauze were packed between the liver and the abdominal cavity and the abdominal wound closed with drainage. The patient's postoperative course was uneventful. The temperature reached normal 3 days after operation and he was discharged on the seventh day to be dressed by the family physician.

**CASE 10** A M a male 25 years of age had a history of several attacks of lower right abdominal pain and finally of an appendectomy 8 months before admission. His condition did not improve and 2 months later he was admitted to the hospital where a subdiaphragmatic abscess was found and drained. He improved somewhat and left the hospital against advice. He returned 5 months later with a draining sinus but again left before he could obtain proper treatment. After a month had passed he returned once more. He had a temperature of 101-102 degrees F with chills pain and tenderness in the upper right abdomen and moderate jaundice white blood cells 17 200. On the day of his admission he was operated upon (Dr J B Carnett) through a right rectus incision. A large liver abscess was found projecting upward beneath the right diaphragm. An opening was made above for drainage via the subdiaphragmatic tract previously opened and one below for drainage through the abdominal incision. The patient improved somewhat for a time but about 3 months later he began to show a high temperature and developed pain in the region of the liver. The abscess cavity was opened and drained again but the patient failed to improve and died 3 weeks later. Necropsy was refused.

**CASE 11** C W a male 12 years of age was admitted to the hospital with the chief complaint of chills and fever. Ten months previously he had an attack of lower right abdominal pain with vomiting and fever and was treated as a case of typhoid fever for 12 weeks. (Probably appendicitis.) He was not benefited however and began to have chills fever

and upper right abdominal pain. Six months after the onset of his trouble he was operated on. Mucus and a few gall stones were found in the gall bladder which was drained. He continued to show a remitting type of fever and had lost considerable weight. On admission his temperature varied between 95 and 104.5 degrees. His liver was found somewhat enlarged and there was a sense of resistance and some tenderness in the right upper abdomen. He was slightly jaundiced. White blood cells numbered 18 000. Urine showed bile pigments. The fluoroscope showed a high right diaphragm. At operation many adhesions were found and separated. The liver was enlarged and there was a marked edema of the gastrohepatic omentum with many enlarged lymph nodes. The common duct was drained and a cholecystectomy performed. The day following operation the patient had a severe chill and 2 days later a distinct jaundice was noted in the skin and sclera. Edema of the lateral abdominal wall with dilatation of the skin capillaries was noted on the tenth day after operation and the fluoroscope showed the diaphragm to be high and fixed. An aspirating needle was inserted in the ninth inter-space in the posterior axillary line and thick foul pus was obtained. The opening was enlarged along the needle and about 8 ounces of pus evacuated. Drainage was inserted and the cavity packed with gauze. When this pus was found the common duct tube was removed. The day following the abscess drainage he became delirious the jaundice was very deep and he refused food. He died 5 days later. At autopsy a well walled off solitary abscess cavity was found occupying a greater part of the right lobe of the liver. On the upper portion the abscess wall had become very thin and was almost ready to rupture into the subphrenic space.

**CASE 12** M I a male 31 years of age after 4 weeks of abdominal pain fever and nausea was seen by Dr Alired Stengel who diagnosed an acute appendicitis with abscess. He was sent to the hospital and operated on at once. The appendix was found acutely inflamed and the abdomen contained seropurulent fluid. An appendectomy and drainage had been done elsewhere. The recovery was normal except for a slight elevation of temperature which was attributed to a stitch abscess. Two weeks after the operation the patient was allowed out of bed for the first time and while sitting quietly in his chair was suddenly taken with acute abdominal pain which continued and became localized in the lumbar region on both sides. When admitted to the University of Pennsylvania Hospital his pain had continued for 6 weeks accompanied by fever of the hectic type and profuse sweats. Pain was constant worse after meals often associated with a bloating sensation and not well localized but mostly on the right side of the abdomen. He had vomited several times had had no chills and had no appetite. He was slightly jaundiced. On examination his chest seemed normal. The abdomen gave an indefinite sense of resistance and marked tenderness especially

over the right side above and external to the right rectus scar. The liver seemed slightly enlarged. The temperature was 101-99 degrees F. pulse 98 respiration 20 white blood cells 14,400. The urine showed a trace of albumin and an occasional hyaline cast. Blood culture was negative. The X ray of the chest was negative. The patient was seen by the writer at this time and a tentative diagnosis was made of postoperative partial obstruction probably inflammatory. At operation 13 days after admission the abdomen was opened through a right rectus incision and the peritoneum was found to contain a large quantity of clear straw colored fluid. A large mass was found in the epigastrium which was composed of indurated mesentery. The induration was most pronounced in the region extending from the appendix up to the gastrophatic omentum involving the latter and the retroperitoneal tissues. This whole area was markedly edematous and the gastrophatic omentum was more than an inch in thickness. The liver showed no surface indicative of disease but deep palpation disclosed numerous nodulations of various sizes highly suggestive of a pylephlebitis of the liver veins substantiated by the induration of the lower portal system. The edematous condition of the mesentery completely obscured the pancreas. Numerous adhesions of the small intestine were separated and it was noted that the resulting bleeding was excessive probably due to the obstructed portal circulation. The wound was closed without drainage. The postoperative diagnosis was pylephlebitis secondary hepatitis with intestinal adhesions causing partial intestinal obstruction. The postoperative course was uneventful except that the temperature rose occasionally above the normal. The patient was discharged 25 days after the operation. Two weeks after his discharge an abscess ruptured spontaneously through the upper end of the wound which drained bile stained pus for several weeks. He is now in good health and without symptoms.

CASE 13. E. G. F. a female 67 years of age was taken sick 9 days before admission with lower right abdominal pain. Three days later she was seen by her physician who made a diagnosis of acute appendicitis and sent her to the hospital. At operation (Dr. F. E. Keene) a retrocecal mass was found well walled off secondary to a ruptured retrocecal appendix. The abscess was drained through a gridiron incision. Five days after operation the temperature was normal and the patient was feeling well. The wound was draining well. On the eighth postoperative day the drainage tube had been removed but the patient began to show an afternoon elevation of temperature to 100.3 degrees F. This continued increasing to 102.2 degrees on the fourteenth day in spite of the fact that the operative wound seemed well drained. An internist who saw the patient 4 days later found complete consolidation of the right lower lobe with tubular breathing but few rales. A diagnosis of atypical lobar pneumonia was made. The patient continued with little change for a week.

An X ray of the chest made on the twenty seventh day after operation showed no lobar pneumonia but a high right diaphragm and a subdiaphragmatic condition was suggested. The following day (4 weeks after operation) the patient was seen by the writer. She was emaciated and pale. Her previous operative wound seemed satisfactory. The right diaphragm was high little movement could be demonstrated. There was a boggy sensation to the lateral abdominal wall over the hepatic region and several small dilated veins were plainly visible. This area was acutely tender on moderate pressure. There was slight jaundice but no nausea. White blood cells numbered 20,100 temperature was 99.6-97 degrees pulse 110 respiration 46. Urine was negative. A diagnosis of hepatic abscess of the right lobe was made. Five days later under local anesthesia 3 centimeters of the tenth rib was resected and an exploring needle inserted through the diaphragm revealed thick yellow pus. An opening was made along the needle with the cautery into a large pocket and about 14 ounces of pus evacuated. Digital examination showed the abscess extending through a finger sized opening into an abscess cavity in the dome of the liver about the size of a hen's egg. Gauze packing was inserted in the cavity. The pus culture showed bacillus mucosus capsulatus. During the week following the operation the temperature gradually returned to normal and remained there with little variation throughout the stay in the hospital. The abscess cavity ceased to drain on the twenty fifth day after operation. The patient gradually regained strength was allowed out of bed on the twenty seventh day and was discharged with the wounds nearly healed 6 weeks after the abscess drainage. She is now in good health and without symptoms.

CASE 14. M. K. female age 29 was operated on for appendicitis and drainage was instituted. Two weeks after operation the temperature began to mount to 101 degrees but there was no chill and the patient developed symptoms of intestinal obstruction with pain tenderness and a mass to the mesial and upper sides of the wound. A few days later this tenderness had extended to the left of the umbilicus. The abdominal wall over the entire right side presented a doughy feel to examination. Peristalsis was diminished except in the upper left quadrant. Pelvic examination revealed an empty ballooned rectum otherwise normal. There was no liver tenderness and the chest examination was negative. White blood cells numbered 18,000. Urine was negative. The diagnosis made was intestinal obstruction due to abscesses among the coils of the ileum. Operation by the writer revealed several abscesses distributed among the coils of the small intestine one of which was obstructed. The mesentery was indurated and fully  $\frac{1}{2}$  to  $\frac{3}{4}$  inch thick on the right side of the abdomen corresponding to the venous channels draining the appendiceal area. Some of the veins appeared to be thrombosed. The liver could not be examined because of adhesions.

An enterostomy was done in the distended gut and the abdomen drained. After a stormy convalescence the patient completely recovered and is now back at her occupation of nursing. Diagnosis: pylephlebitis, abdominal abscesses, and intestinal obstruction.

## SUMMARY

1. Pylephlebitis and liver abscess are not identical and occur as a complication in from 0.1 to 0.4 per cent of cases of appendicitis.

2. The X-ray and fluoroscope aid in early diagnosis by showing a high diaphragm sometimes with restricted movement.

3. Local oedema and prominent veins are valuable diagnostic signs.

4. Pain is not always present. It is noted most when the infection is in or on the upper surface of the liver.

5. Pneumonic signs are frequently the result of lung compression rather than pneumonia.

6. Jaundice is practically a constant symptom.

7. The presence of lassitude and anorexia is very suggestive in the diagnosis.

8. The prognosis is not universally bad as 54 per cent of the patients recover.

9. Operation through the diaphragm is the treatment of choice.

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# ANTERIOR ABDOMINAL HYSTEROTOMY FOR THE INTERRUPTION OF PREGNANCY AND STERILIZATION ITS INDICATIONS<sup>1</sup>

By PHILIP OGINZ M.D. BROOKLYN NEW YORK

**I**NTERRUPTING pregnancy by anterior abdominal hysterotomy and at the same time sterilizing the patient is a procedure that has not been practiced in this country, even when the condition indicated the advisability of the operation. One must come to this conclusion after a careful search through the literature of the past 40 years. The only reference that I was able to find is a report of a case by Charles Child Jr. in 1910. It is probable that gynecologists and obstetricians have long practiced some such procedure for combined abortion and sterilization per abdomen. However we have not attached sufficient importance to the subject considering the seriousness of the problem and the difficulty it often presents in the matter of judgment. Abroad this type of operation has not been neglected and various methods, modifications and improvements have appeared from time to time. I have had occasion to operate in 18 cases of this nature and have gradually evolved a simple technique the elements of which in all probability have been utilized by others but in a somewhat diligent manner. The use of this method where there are positive indications for it, has proved an excellent way of handling these difficult cases.

At the meeting of the New York Obstetrical Society where Dr. Childs reported his case Dr. Polak mentioned that on three different occasions he had employed a somewhat similar procedure. The method described by Childs consisted in opening the abdomen by a low transverse incision making the posterior fundal uterine incision reach both cornua emptying the uterus and then resecting the isthmus portion of the tubes and burying the free ends in the folds of the broad ligaments then dilating the cervix and packing the cavity with iodoform gauze. Such a technique was followed by the Germans for several years until 1913 when Selheim made the transverse uterine incision immediately below the fundus

posteriorly and then resected either part or the entire tube, thereby doing away with the danger of infecting the uterine cavity through the cut tubal ends. This method was shortly followed by one which utilized a longitudinal incision on the posterior surface and then resected either a part or the entire tube. Subsequently the longitudinal incision was brought to the anterior surface of the uterus in the cervical region. This necessitated the peeling back of the bladder deflection and involved great risks of infecting the normally sterile uterine cavity with infection of the cervix which almost always is present.

Dorfler in a recent article entitled "*Kleiner Kaiser Schnitt*" advocated peeling back the bladder making a low cervical incision emptying the uterus, then resuturing the bladder over the incised area in an attempt to eliminate the raw surface. He sterilized by resecting part of the tube.

There still remain to be mentioned several other ways of combining therapeutic abortion and sterilization in one operation. Some gynecologists have tried the vaginal route first emptying the uterus then deflecting the bladder opening the anterior cul de sac bringing out the uterus resecting the tubes and finally closing the cul de sac bringing down the bladder and closing the anterior vaginal wall. Thus they avoid opening the abdomen at the expense of a procedure requiring much more time a much greater loss of blood and a far more difficult technique.

Other methods that have been employed by various surgeons are the following:

One is to empty the uterus by curettage and to send the patient home to recuperate with the understanding that she is to return for a sterilization operation later. This is almost uniformly a failure for the patient rarely comes back until she is pregnant again. In the meantime her general health is being undermined by a constant dread of a possible pregnancy. Another is the combined method of



emptying the uterus from below and then subjecting the patient to X ray or radium. This is of value in women approaching the menopause, but should not be used in young women because of the sudden artificial menopause it causes. I will just mention in passing repeated curettage without sterilization. This is merely a palliative measure and is entirely inadequate. It involves the subjection to repeated anesthetics and operative interferences which may prove disastrous.

Abdominal hysterotomy with sterilization is performed only on women who are exceedingly poor surgical and anesthetic risks. The characteristics of what might be called the ideal operation for these cases are the following:

1. The procedure must be sufficiently simple to come within the surgical skill of even the occasional operator. In other words it should not be more difficult than a simple appendectomy.

2. The blood loss should be reduced to the absolute minimum.

3. Sterilization must be complete.

4. The operation must require very little time for its completion.

5. The anatomical or structural relationships must be disturbed as little as possible so that

6. The operation can be done under ether gas, local or spinal anesthesia with equal facility.

The technique which I have followed for the past 4 years fulfills all these requirements and can easily be done by the average gynecologist or surgeon within the half hour under any form of anesthesia.

A mid abdominal incision is made from an inch or two below the umbilicus to the symphysis. The uterus is seized by a tenaculum brought out of the abdomen and then well washed off by lap sponges. A 4 or 5 centimeter incision is made in the midline beginning at the fundus and extending toward the cervix through all the uterine coats. The membranes usually bulge through the incision and are ruptured. The embryo and placenta are detached and removed with a gauze wrapped finger or a sponge stick forceps introduced into the cavity of the uterus. Here a little diffi-

culty is encountered because the spongy layer of the decidua is not fully developed and does not separate easily. There is little bleeding from the placental sinuses. The delivery of the membranes and the placenta is followed by an injection of 1 cubic centimeter of pituitin directly into the uterine musculature. This contracts the uterus fairly well. A continuous suture of No. 2 plain catgut brings the musculature of the uterus together but does not take in the endometrium. A second seromuscular layer of continuous No. 2 plain gut followed by a peritonealization of the raw surface closes the uterus firmly, preventing any possible leakage. The tube is now grasped by an artery clamp at its isthmus portion and picked up so that a knuckle is formed. A fine needle carrying silk is passed under the tube at the apex of the knuckle and tied first over one limb and then over the other. The apex of the knuckle is cut off with the scissors and both raw surfaces are cauterized by thermocautery or carbolic and alcohol. The same is repeated on the other tube. A rapid inspection is then made and the abdomen is closed. The operation is followed by as little post-operative inconvenience as that following an interval appendectomy. In my series of cases very little pain was experienced and the temperature never rose to over 100.5 degrees F. The patients were returned to the care of the medical men on the tenth or twelfth day after the operation. During convalescence very moderate vaginal bleeding due to the throwing off of small placental rests is a common finding. Not a single one of my cases showed any morbidity.

The operation can be done at any time during the pregnancy.

In the early months a 2 inch abdominal incision just large enough to admit two fingers may be adequate for the entire operation.

The anterior uterine incision has the advantage over the posterior one in that while the latter may cause adhesions to either the omentum or the intestines the former may cause adhesions to the bladder or to the anterior abdominal wall which only serve to suspend the uterus. The above method of treating the tubes is better than any type of resection inasmuch as it does not interfere

with the anastomosing circulation between the uterine vessels and the ovary. If the tubes are resected the utero ovarian anastomosing vessels are removed and the ovary may become cystic.

It is of importance to note that in Europe special curettes and dilators were devised to clean and dilate the uterus from above. However I have found it absolutely unnecessary to use either curettes, dilators or uterine packings.

Because of the ethical and moral principles involved as well as because of the bad operative risks which the cases present this operation must never be considered except when certain definite indications exist and then only after an internist and a gynecologist have held a consultation. As a gynecologist I can only enumerate the conditions in which the operation is indicated and give you the opinions of several internists as expressed to me. This operation is indicated for those women who are suffering from a chronic debilitating disease with little or no hope of a cure and in cases in which experience has shown that the continuation of the pregnancy would certainly shorten or even terminate the patient's life. Specifically the diseases wherein these conditions are indicated come under four groups: (1) pulmonary tuberculosis, (2) certain cardiac diseases, (3) chronic nephritis and hypertension and (4) unusual cases.

1. *Pulmonary tuberculosis.* Abortion and sterilization should be effected in cases of pulmonary tuberculosis which run a subacute course characterized by fever, rapid pulse, sweats and loss of weight and especially by one or more previous therapeutic abortions for a similar condition. For example:

CHART NO. 1738. M. H. age 24 born in the United States was admitted into the King's County Hospital July 5, 1923. She is pregnant and has tuberculosis. Doctor said that she should come to the hospital to have an abortion performed.

There was a history of two therapeutic abortions one in 1921 and the other in 1922, two pulmonary hemorrhages within 1 year and positive sputum. The patient had lost 20 pounds and had had no children.

The diagnosis of a 10 weeks' pregnancy was made. Medical consultation. Pregnancy too much for her on this occasion. The condition makes it absolutely necessary that she shall not carry this conception.

Her health depends upon longer freedom from extra burden. Termination demanded.

An abdominal hysterotomy with sterilization was performed on July 9, 1923 with gas as the anæsthetic. The operation was completed in 25 minutes. On the tenth day, the patient was permitted out of bed. She was discharged on July 21, 1923 with primary union of abdominal wound, no induration, no tenderness and the pelvis entirely negative.

This case illustrates the uselessness of abortions without sterilization. The patient already had undergone two operative procedures in both of which anæsthesia had been induced and on both occasions she had been emphatically instructed that it would be dangerous to become pregnant again. She was told to return at a later date for sterilization. Without a doubt each pregnancy as well as each abortion aggravated the lung condition. In order to give the lungs a chance to heal and to eliminate the dread as well as the actuality of another pregnancy it was necessary to accomplish abortion accompanied by sterilization.

In this connection it is interesting to note that according to M. A. Couvelaire, 38 per cent of children born of tuberculous mothers removed from their mothers immediately after birth and brought up under the best conditions do not survive their first month.<sup>1</sup>

2. *Cardiac indications for sterilization.* Aortic regurgitation is a positive bar to pregnancy because the strain upon an overburdened left ventricle may be great enough to cause acute dilatation of the left heart with the onset of pulmonary oedema. Especially dangerous are the cases of aortic regurgitation complicated with a relative mitral regurgitation or that have at any time become decompensated. Sterilization is indicated if there is a mitral lesion and the cardiac reserve has become exhausted as evidenced by repeated attacks of decompensation. This is especially true of mitral stenosis. In cardiac arrhythmias, auricular fibrillation is the most important indication. Myocardial degenerations due to chronic infections should be relieved of the strain of possible pregnancies.

An example is the case of I. S., 34 years of age, gravida IV, III para, admitted to the Brownsville and East New York Hospital on March 16, 1924.

<sup>1</sup>Bull. French Soc. Obst. & Gynec. 1933, 21.

three months pregnant suffering from marked symptoms of a breaking cardiac compensation associated with mitral stenosis. With her previous pregnancies her heart had been bad. In the medical consultant's opinion the condition of her heart was such that pregnancy was a distinct menace to her life. Anterior abdominal hysterotomy with sterilization was performed March 20, 1924, under gas oxygen anesthesia. On the day after the operation the temperature rose to its highest point 100.5 degrees F. After that it remained normal. The patient had a slight infection of the upper angle of the wound. On her discharge on April 6, 1924, the cardiac action showed improvement, more regularity and a better quality to heart sounds. The examination of the pelvis was negative.

3 *Chronic nephritis and hypertension* In the glomerular type of nephritis, if it is known that the glomeruli are wanting in regenerative power and that the disease is little affected by medication and treatment and if hypertension is present, there can be no question as to the advisability of interrupting pregnancy with sterilization.

If the kidney is nephrotic, sterilization is indicated only when it is found that each pregnancy causes an acute exacerbation and the development of vascular changes. The chronic hypertension of the nephritis calls for a special indication because of its effect on the cardiac condition. Labor entails a relatively sudden increase of blood pressure, sometimes as great as 50 millimeters. This is illustrated by the following case:

CHART NO 12195 R. L. age 23, was admitted to the Brownsville and East New York Hospital complaining of headache and vomiting.

The history showed that she had been married two years. The first pregnancy advanced to 6 months when uræmic symptoms developed and a premature delivery was necessitated. Labor was induced by catheter and packing, now pregnant about 6 months. The medical diagnosis was acute exacerbation of a chronic nephritis.

The urine examined between the first and second pregnancies had always showed albumin and casts. The blood pressure was always above normal. The physical examination on admission showed that she was suffering from a slight cardiac enlargement, a blood pressure of 214/140, the urine boiled solid and showed granular casts and red blood cells. Ophthalmological examination showed both disks and rest of fundus with moderate amount of oedema. In both the macular and paramacular regions were a number of small dot like retinal exudates. The retinal blood vessels exhibited no evidence of sclerosis.

In consideration of her behavior during the last pregnancy the history of hypertension and albumi-

nuria between pregnancies and the present findings, termination of pregnancy with sterilization was considered advisable.

Anterior abdominal hysterotomy with sterilization was done three days after admission under local anesthesia induced with  $\frac{1}{2}$  per cent novocain. The postoperative course was uneventful and the patient was transferred to the medical service on the tenth day. The blood pressure was 190 and only a trace of albumin was present in the urine.

4 There remain only the unusual cases which will merely be mentioned since they only occasionally require the treatment under discussion. These are cases of (a) recurrent toxæmia, (b) complicated diabetes, (c) certain nervous and mental diseases such as chorea, (d) blood diseases such as pernicious anemia and leukæmia, and (e) severe thyrotoxicosis. These cases do not permit of a generalizing law. Each one must be judged on its own merits.

When it is first presented this method of abortion with sterilization per abdomen seems to be a very radical procedure. However, experience with it soon demonstrates that in the indicated cases the patients stand the operation very well and recuperate rapidly. No operator either here or abroad has reported any mortality attributable directly to the operation itself. This is noteworthy, when we consider the fact that the women they had to deal with were all very sick. The technique which I have followed and described to you fulfils all the requirements in that it is simple, entails very little blood loss, it is certain to sterilize, is time saving and any kind of an æsthetic can be used. The diagnosis of the conditions I have outlined specifically indicates this operation as definitely as the diagnosis of an ectopic pregnancy indicates salpingectomy.

#### SUMMARY

The operation of hysterotomy for the interruption of pregnancy and sterilization is of great value in certain cases of pulmonary tuberculosis, cardiac diseases, chronic nephritis and hypertension and some unusual cases and could be used to the patient's advantage much more often than has been the practice in this country.

Let me here publicly thank Drs. Gordon Frucht Dattlebaum and Harns who have kindly given me the views as to the pathological conditions that form the basis of the indications for operative procedure.

# END-RESULTS IN THE INTERPOSITION OPERATION FOR THE CURE OF PROLAPSUS UTERI AND CYSTOCELE

By FREDERICK W. JOHNSON, M.D., F.A.C.S., BOSTON

Gynecologist-in-Chief, Carney Hospital

THE interposition operation described by the late Thomas J. Watkins of Chicago is the foundation on which I have built, but my operation differs from any I have seen described in that the whole anterior surface of the uterus down to the cervix is sewed to the fascia of the anterior vaginal wall. Thus you get the uterus firmly fixed in anteversion to the fascia and the bladder resting on the posterior aspect of the body of the uterus.

In the April 1919 number of SURGERY, GYNECOLOGY AND OBSTETRICS my associate at the Carney Hospital, Dr. L. E. Phaneuf, and I tabulated 90 cases of the interposition operations and the end results in 68 of them.

The first was operated on May 31, 1909, and the last May 5, 1918, an average of about 10 a year. Eighty-nine were operated on at the Carney Hospital. The mortality was nil. The oldest patient in this series was 69, the youngest 21. Forty-six were between 50 and 60 years of age, while thirty were between 40 and 50.

Almost all of the cases were from the laboring class and as soon as possible were obliged to return to their homes and household duties—just the class that would put any operation for prolapsus and cystocele to its severest test.

From answers received from 68 patients it appeared that 54 had been wholly relieved of the troubles complained of at the time of operations; there had been no falling down of the parts and there had been improvement in their general health. This certainly is gratifying, as I know of no other operation for prolapsus uteri and cystocele attended with almost no danger and no shock that gives as good end results.

It is an operation from which elderly and old women recover quickly.

Since May 5, 1918, when the last case in the above series was operated on, up to July 1923, I did this modification of the interposition

operation on 50 patients—about 10 a year or a little over, as I was away 15 months out of these 5 years. In this series, as in the other, the oldest patient was 69. The youngest was 30. Twenty-one were between 50 and 60 years of age, 18 were between 40 and 50 years of age. It was found necessary to repair or amputate the cervix in 41 cases (52 in the former series) and Crossen's or Bandler's operation for relaxed pelvic outlet and rectocele was done in 45 cases (76 in the former series). The mortality was nil.

All in this series of 50 were operated on at the Carney Hospital. Letters were sent to each of the 50 patients excepting those who came to my office for examination, and the following questions were asked:

1. Did the operations relieve you of the troubles of which you complained?
2. Is there falling down of the parts?
3. To what extent has your general health been improved by the operations?

I received 32 replies out of the 50.

It appeared that 27 out of the 32 had been wholly relieved of the troubles complained of at the time of operations; there had been no falling down of the parts and there had been improvement in the general health. Two got partial relief. There was total failure in 3 cases. By this I mean the cervix again presented at the vulva. These were cases of enterocele which I did not recognize at the time of operation but had considered very large rectoceles. Twenty-seven complete cures (nearly 90 per cent) out of 32 patients operated on certainly speaks well for this method of dealing with prolapsus uteri and its accompanying cystocele and rectocele.

In the two series there were 140 patients operated on; reports of end results were obtained in 100 cases, and 87 patients reported they were wholly relieved.

The opening into the peritoneal cavity anteriorly must be large enough so that the

uterus may be easily and well drawn through into the vagina so that the bladder will lie smoothly, not in folds and the base be not elevated on the posterior surface of the fundus uteri. For unless these precautions are taken the patient will be very uncomfortable and will complain of symptoms pointing to an irritable bladder.

In almost all of these cases residual urine containing pus, bladder epithelium and colon bacilli will be found and cystoscopy will show a chronic trigonitis. This ought to be cured before operation and it can easily be done in a few days by keeping the patient in bed by thoroughly emptying the bladder with

a catheter twice a day, irrigating the bladder with a 4 per cent solution of boric acid and after thoroughly draining the bladder instilling into it 2 ounces of a 1:1000 solution of mercurochrome—220 soluble.

For the following reason the bowels are not moved for 7 days. Even though the greatest care is exercised in giving an enema and in cleaning the anus and parts about after defecation the perineum becomes a little soiled and the perineal sutures may thus become an easy prey to the micro organisms present.

The kind of diet for the 7 days is such that there is no accumulation of feces in the rectum.

## THE CLINICAL APPLICATION OF RECENT STUDIES ON JAUNDICE

By ALBERT M. SWELL, M.D. ROCHESTER, MINNESOTA  
D. am. 131, 141a, 150, 161, 171, 181, 191, 201, 211, 221, 231, 241, 251, 261, 271, 281, 291, 301, 311, 321, 331, 341, 351, 361, 371, 381, 391, 401, 411, 421, 431, 441, 451, 461, 471, 481, 491, 501, 511, 521, 531, 541, 551, 561, 571, 581, 591, 601, 611, 621, 631, 641, 651, 661, 671, 681, 691, 701, 711, 721, 731, 741, 751, 761, 771, 781, 791, 801, 811, 821, 831, 841, 851, 861, 871, 881, 891, 901, 911, 921, 931, 941, 951, 961, 971, 981, 991, 1001, 1011, 1021, 1031, 1041, 1051, 1061, 1071, 1081, 1091, 1101, 1111, 1121, 1131, 1141, 1151, 1161, 1171, 1181, 1191, 1201, 1211, 1221, 1231, 1241, 1251, 1261, 1271, 1281, 1291, 1301, 1311, 1321, 1331, 1341, 1351, 1361, 1371, 1381, 1391, 1401, 1411, 1421, 1431, 1441, 1451, 1461, 1471, 1481, 1491, 1501, 1511, 1521, 1531, 1541, 1551, 1561, 1571, 1581, 1591, 1601, 1611, 1621, 1631, 1641, 1651, 1661, 1671, 1681, 1691, 1701, 1711, 1721, 1731, 1741, 1751, 1761, 1771, 1781, 1791, 1801, 1811, 1821, 1831, 1841, 1851, 1861, 1871, 1881, 1891, 1901, 1911, 1921, 1931, 1941, 1951, 1961, 1971, 1981, 1991, 2001, 2011, 2021, 2031, 2041, 2051, 2061, 2071, 2081, 2091, 2101, 2111, 2121, 2131, 2141, 2151, 2161, 2171, 2181, 2191, 2201, 2211, 2221, 2231, 2241, 2251, 2261, 2271, 2281, 2291, 2301, 2311, 2321, 2331, 2341, 2351, 2361, 2371, 2381, 2391, 2401, 2411, 2421, 2431, 2441, 2451, 2461, 2471, 2481, 2491, 2501, 2511, 2521, 2531, 2541, 2551, 2561, 2571, 2581, 2591, 2601, 2611, 2621, 2631, 2641, 2651, 2661, 2671, 2681, 2691, 2701, 2711, 2721, 2731, 2741, 2751, 2761, 2771, 2781, 2791, 2801, 2811, 2821, 2831, 2841, 2851, 2861, 2871, 2881, 2891, 2901, 2911, 2921, 2931, 2941, 2951, 2961, 2971, 2981, 2991, 3001, 3011, 3021, 3031, 3041, 3051, 3061, 3071, 3081, 3091, 3101, 3111, 3121, 3131, 3141, 3151, 3161, 3171, 3181, 3191, 3201, 3211, 3221, 3231, 3241, 3251, 3261, 3271, 3281, 3291, 3301, 3311, 3321, 3331, 3341, 3351, 3361, 3371, 3381, 3391, 3401, 3411, 3421, 3431, 3441, 3451, 3461, 3471, 3481, 3491, 3501, 3511, 3521, 3531, 3541, 3551, 3561, 3571, 3581, 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the vena cava to form an Eck fistula. They showed further that bilirubin, which cannot be demonstrated in dog serum by the usual tests, was formed in animals with a cephalic and thoracic circulation only the liver having been entirely excluded. Mann and his associates (19) at the Mayo Clinic have furnished positive proof by removing the liver from dogs using a three stage operative technique which permits the survival of the animal for a period of from 24 to 36 hours. During this time a definite icterus develops, bilirubin appearing in the blood stream in considerable amounts. More recently they have obtained similar results in animals after complete extirpation of the liver by a single operation; their findings have been confirmed by Rich and Makino.

The source of bilirubin is now generally conceded to be hæmoglobin set free during the normal destruction of blood within the body, hæmatin being transformed into bilirubin by the loss of the iron containing portion of the molecule. The remaining fraction formerly spoken of as hæmatoidin is chemically identical with bilirubin as has been shown by Rich and Burnstead. The actual transformation of hæmoglobin to bilirubin has not as yet been satisfactorily accomplished *in vitro* but it has been repeatedly observed in the living animal. The local formation of bilirubin in hæmorrhagic effusions as originally demonstrated by Virchow is a well established fact. It is also known that the intravascular injection of laked blood or solutions of hæmoglobin causes a sharp increase in the bilirubin output of animals with biliary fistulas. In Mann's liverless dogs increased bilirubinæmia follows this procedure. Recently Rous and Drury have suggested that the level of serum bilirubin in dogs with obstructive jaundice bears a direct relationship to the rate of destruction of red blood cells.

It has been suggested by Aschoff and others that this transformation of hæmoglobin to bile pigment is accomplished by means of the reticulo endothelial system. These cells are widely distributed throughout the body, the endothelial cells of the spleen, bone marrow, and lymph glands, and the Kupffer cells of the liver belonging to this group. They act as

phagocytes and are known to take up broken down red cells, the hæmoglobin within the corpuscles being digested and the iron containing portion hæmosiderin being deposited in the endothelial cells themselves. It is believed that the iron free portion, either bilirubin or some substance of similar chemical composition, is returned to the blood stream. This hypothesis at once explains the results of Minkowski and Naunyn, since the livers of geese contain the greater part of their reticulo endothelial structures. In liverless birds the dissolution of hæmoglobin and the subsequent formation of bilirubin were therefore greatly unpaired.

Rich (24) in his recent review of the subject of extrahepatic formation of bilirubin, considers it proved that hæmoglobin is the sole source of bile pigment. He believes that there is no evidence that the polygonal cells of the liver or the cells of any other tissue except possibly those of the reticulo endothelial system ever form bile pigment; the evidence that the latter cells manufacture bilirubin is not sufficiently complete to be regarded as proof, although the great probability of such a process is conceded.

The normal pathway of excretion of bilirubin is by way of the polygonal hepatic cells. In certain types of jaundice it may be excreted by way of the kidney. In general it may be said to behave as a threshold substance with regard to both organs.

On the basis of this theory of bilirubin metabolism, McNee (25) has evolved a theory of jaundice which correlates very well the clinical facts and experimental data now available. By a schematic representation of the liver lobule he has demonstrated the possibilities of pathological interference with formation and excretion of normal bile pigment. He regards the polygonal hepatic cells as forming a tubule with a blind end, the free end passing into a bile capillary. Surrounding each tubule lie hepatic vascular capillaries lined with Kupffer cells of the reticulo endothelial system and carrying blood from the portal to the hepatic vein. Jaundice may be produced in one of three ways. If the bile passages are occluded bilirubin which has passed through the vascular channels and

polygonal liver cells, is reabsorbed by the blood stream and lymphatics. This type of jaundice is described as 'obstructive'. If there is an abnormally large production of bilirubin or its precursors within the body, or if there is an impediment to the passage of this substance through the endothelial lining of the hepatic capillaries, bilirubin will accumulate and enter the general circulation without being passed through the hepatic cells proper. This type of jaundice is referred to as hæmolytic. Finally, if there is hepatic damage functional or otherwise not only may normally formed bilirubin fail of excretion but also that which has passed through the polygonal cells of the liver may be reabsorbed. This is the type of jaundice described as 'toxic' or 'infectious'. McNee (15), therefore following Osler and Rolleston proposes that jaundice be classified into three clinical varieties: obstructive, hæmolytic and toxic or infectious.

The studies of van den Bergh furnish an interesting corollary to the foregoing hypothesis and incidentally constitute a most important addition to our knowledge of icterus. By developing the well known Ehrlich diazo reaction and adapting it to the estimation of bilirubin in serum, he has produced the most delicate chemical method yet available for this test and centered interest in icterus on the amount of pigment in the blood rather than on that noted in the skin and excreta. His method may be briefly stated as follows: on the addition of Ehrlich's diazo reagent to serum in the presence of obstructive jaundice a purple color appears immediately. This is called the direct reaction. In certain instances, particularly in toxic jaundice, the color appears slowly, the reaction then being delayed or biphasic. On the addition of alcohol a rose colored azobilirubin is formed; he terms this the 'indirect' reaction. The amount of azobilirubin formed in the latter reaction can be estimated colorimetrically and the amount of bilirubin in the circulating blood calculated. Normal human blood contains from 0.5 to 2.0 milligrams of bilirubin for each 100 cubic centimeters as shown by the indirect reaction. This test permits the exact estimation of the degree of bilirubinæmia.

Van den Bergh has investigated the point further and believes that chemically pure bilirubin and that obtained from the gall bladder and bile passages are somewhat different substances. The direct reaction is only given by the latter, whereas the former requires the addition of alcohol for the development of any color whatever. He interprets this as the result of changes in the substance probably occurring during its passage through the polygonal hepatic cells. By adapting van den Bergh's view to his own theory, McNee (15) has suggested that a direct reaction is diagnostic of obstructive jaundice, that the indirect reaction is obtained in all types as well as in normal human serum and that a biphasic or delayed type of direct reaction would be expected in cases of jaundice of toxic or infectious origin.

In the experience of many continental investigators this differentiation seems to work out fairly well. My own studies with the method are not so conclusive. Without discussing the matter in too much detail it would seem that direct reactions are obtained in high degrees of jaundice from whatever cause, possibly increased viscosity of bile with the formation of obstructing bile thrombi (as suggested by Eppinger 8) may play a part. I have also noted the accumulation of bilirubin giving the indirect reaction in animals with obstructive jaundice prior to the appearance of the direct reaction. I have felt that a sharp differentiation of obstructive and non-obstructive jaundice was not always possible on the basis of van den Bergh's test alone. The time honored examinations of the urine and stools for bile pigment are still of great value in this connection. The quantitative estimation of bilirubin in the blood, however, is of the greatest clinical and scientific value.

The retention of substances other than bilirubin complicates the clinical picture of jaundice caused by occlusion of the biliary passages. Chief among these other constituents of bile are the bile acids, glycocholic and taurocholic; their effect on the organism is undoubtedly most important. The present knowledge of the physiology of bile acids is very limited; they are however probably formed exclusively by the hepatic cells. Their chologogue

action is well known, some evidence exists to show that they are reabsorbed from the intestine and act in this way as a stimulus to the further production of bile.

The effect of the retention of bile acids on the organism is very imperfectly understood. Cholic acid is known to be toxic; it acts on heart muscle similarly to digitalis and may also cause degeneration of the renal tubules. Macht and Hyndman have suggested that the toxicity of bile may depend on the cholic fraction of the bile acids. French clinicians have attributed the bradycardia and pruritus observed in cases of jaundice to these acids.

The whole subject of the metabolism of bile acids and their precise effect on the organism in cases of jaundice remains uncertain pending the perfection of a method for their quantitative determination on the blood. Aldrich, Rowntree and Greene of the Mayo Clinic and McNee (14) have independently evolved such methods and are at present engaged in further studies.

The conception of dissociated jaundice that is a selective retention of either bile acids or bile pigments is to be attributed to men of the French school notably Brul-Chauffard and Vidal. Their conclusions were based on the study of the products of the metabolism of bile in the stools and urine and consequently are not entirely conclusive. Hoover and Blankenhorn reviewed much of this work in 1916; they attempted a study of these substances in the blood stream and described retention of bile acids in cases of primary anemia and lead poisoning without any retention of bile pigments. A further review of this whole subject newer methods being used would be of great clinical interest.

The clinical importance of these new conceptions of jaundice has only recently been properly appreciated. Recent knowledge of the mechanism by which jaundice is produced together with van den Bergh's method of studying the bilirubin content of the blood has been of much value in clarifying a number of obscure points with regard to hepatic disease. The recognition of latent jaundice obviously a most important point has also been made possible by this method. Previously the only reliable aids were the scleral color and

the presence of bile in the urine. A serum bilirubin content of from 3 to 5 milligrams is necessary before the urine gives the usual tests for bile in cases of obstructive jaundice; in cases of hemolytic jaundice considerably larger amounts may be present without any passing through the kidney. A threefold to fivefold increase in the serum bilirubin is necessary for the production of clinically demonstrable icterus. A number of recent observations tend to establish the belief that the affinity of body cells generally for bilirubin is not great; the quantity of the pigment present in jaundiced tissues remaining relatively low and constant in spite of wide fluctuations in the quantity in the serum. These facts demonstrate the obvious advantage of the direct study of the blood in cases of jaundice.

Van den Bergh's test therefore will furnish earlier and more accurate information regarding the onset of jaundice than any other means at the physician's command. The clinical value of the test has been emphasized by van den Bergh, de Takáts and others. In my experience it has aided in the recognition of hepatic congestion in cases of early myocardial failure in the differential diagnosis of anemia due to destruction of blood in the identification in some instances of a typical gall stone colic and in the early demonstration of jaundice following obstruction of the common duct. Carotinæmia may also be distinguished from jaundice by this means. The test is also useful to the surgeon as a quantitative measure of jaundice aiding materially in the selection of a time for operating on patients whose jaundice may be increasing or subsiding. Its value in this capacity has been particularly emphasized by Judd who also considers it a most valuable aid to prognosis. Finally, fluctuations in the content of bilirubin in the serum may be significant in distinguishing jaundice due to stone in the common duct with partial obstruction from the progressively increasing type seen in pancreatic carcinoma and stricture of the common duct.

The pathological changes in the liver associated with jaundice have been widely discussed. The reaction of the liver to toxic or bacterial injury is a proliferation of connective tissue with subsequent cirrhosis. The degree



and type of cirrhosis depend on the virulence of the toxin and its method of entry. Obstruction of the common duct produces biliary cirrhosis with the primary proliferative changes occurring in the region of the biliary capillaries. The cirrhosis due to alcohol, copper, pepper and other irritants absorbed from the intestinal tract by way of the portal vein shows a primary change in the vicinity of the portal capillaries.

In cases of toxic or infectious jaundice the initial damage occurs in the polygonal hepatic cells themselves. All degrees of pathological change from simple cloudy swelling to actual necrosis being observed. The portal spaces and biliary capillaries are only secondarily affected. The relationship of cirrhosis to jaundice of this type is obviously of great clinical interest. McNee (14) and others have suggested that all the changes observed in such conditions ranging from simple hepatitis to acute yellow atrophy and cirrhosis of high grade are all part of the same pathological process. This point is well illustrated by the hepatic changes observed in syphilis. The combination of salvarsan and syphilis may produce all of these grades of hepatic damage from the mildest to the most severe. Cases have been observed to progress from the stage of mild transient jaundice to a terminal *hepar lobatum* with ascites. Exactly similar observations have been made in cases of poisoning with trinitro toluene and tetrachlorethane. The pathological process progressing gradually over a period of years. I have had the opportunity of studying several cases of toxic jaundice of unknown origin in which no obstruction of the bile passages could be demonstrated. In these cases the development of definite cirrhosis was confirmed by biopsy made at the time of exploration. The conception of a progressive hepatitis with variable degrees of jaundice and increasing cirrhosis is of the greatest interest to the surgeon and internist.

Continental physicians notably Eppinger (9) have been much interested in the relation of the reticulo endothelial system to hepatic and splenic disease. The cirrhosis associated with splenomegaly, Banti's disease and certain types of biliary cirrhosis have been considered as 'liver spleen diseases' (9) and

the improvement following splenectomy explained on the basis of a removal of a functional overload on the liver. W. J. Mayo has said that certain splenic diseases involving as they do the reticulo endothelial system may cause the elaboration of toxic substances which when carried to the liver by the splenic vein produce splenic types of hepatic cirrhosis. He has also demonstrated that splenectomy is of considerable benefit in selected types of biliary cirrhosis as well as in portal cirrhosis associated with ascites.

Prolonged coagulation time has long been known to be a fairly constant finding in cases of obstructive jaundice and hemorrhage was formerly one of the most feared postoperative complications as well as the chief cause of a high surgical mortality. The use of calcium chloride intravenously as advocated by Walters has served to reduce very greatly the occurrence of such hemorrhages. Since the general adoption of his method there has also been a marked decrease in operative mortality following surgical procedures in jaundiced patients. The cause of prolonged coagulation time in cases of icterus still remains obscure. In cases of both clinical and experimental obstructive jaundice it is known that the serum calcium is constantly within normal limits while the blood fibrinogen content is normal or even increased. It has been suggested that a chemical union between the blood calcium and some constituent of the retained bile may exist rendering the calcium inert and incapable of performing its usual function in the coagulation of blood. Such a union however has not been satisfactorily demonstrated.

A recent revival of interest in studies of hepatic function has resulted in a number of interesting observations on its relation to jaundice. A group of us at the Mayo Clinic (10-11-30) has recently made a survey of the subject and studied certain of the more promising tests of hepatic function in cases of experimental and clinical obstructive jaundice. In the experimental series a number of these tests were performed on dogs following ligation of the common bile duct. Cholecystectomy was combined with ligation of the common duct in half of the animals used in order to hasten the development of icterus. In both groups the

hepatic functions relating to carbohydrate and protein metabolism were somewhat, but not seriously, altered. Diminished formation of urea, as shown by sharp decreases in the blood urea and non protein nitrogen, occurs almost at once after operation. Uric acid however did not accumulate in the blood as it does in dogs after hepatectomy. An impairment of carbohydrate metabolism as evidenced by decreased fructose tolerance developed from 6 to 11 days after the onset of jaundice. The fasting level of the blood sugar usually remained within normal limits although moderate hypoglycæmia, which did not respond to the administration of fructose was noted in two animals before death.

In the clinical series similar but somewhat less definite results were noted. In about half of the cases studied the fructose tolerance was lowered. Blood urea values showed on the average a slight decrease but did not in any case fall below the lower limits of normal. In brief the failures of carbohydrate and protein metabolism which characterize Mann's dehepatised dogs were not approached in either the clinical or experimental series. This perhaps is to be expected in an organ with so large a factor of safety as the liver.

From the standpoint of treatment however the impairment of carbohydrate metabolism is of considerable importance. It has long been known that a high carbohydrate diet protects the liver very effectually against experimental toxic injury. Mann (18) has found that feeding glucose has greatly increased the period of survival of animals after the induction of obstructive jaundice. These two points have been utilized clinically in the post operative management of patients with long standing obstructive jaundice presenting the syndrome of hepatic insufficiency described by Walters and Parham. In a number of such cases observed at the clinic the intravenous administration of glucose has been a most effective method of treatment producing remarkable and permanent improvement in several practically moribund patients.

The excretory functions of the liver as measured by the use of dyes show much more definite impairment in cases of obstructive jaundice than those related to carbohydrate

and protein metabolism. The results of the Rowntree Rosenthal phenoltetrachlorophthalein test in both the experimental and clinical series already mentioned were very striking. In animals maximal retention of dye was observed 24 hours after cholecystectomy and ligation of the common duct. In animals whose gall bladder had been left intact, jaundice and retention of dye developed somewhat more slowly. In both groups of animals however the level of serum bilirubin on successive tests was almost exactly parallel to the degree of retention of the dye suggesting a possible relation in the manner of excretion of the two substances. In patients with obstructive jaundice the same striking parallelism of bilirubinæmia and retention of dye was observed. The uniformity of this finding did not appear to be influenced by the duration of the jaundice or the etiological agent involved. Rosenthal using phenoltetrachlorophthalein and Delprat, Epstein and Kerr, using rose bengal have demonstrated dye retention in patients with obstructive jaundice; their results are similar to those obtained at the clinic (10, 11, 30).

These observations naturally raise the question of the accuracy of conclusions based on the dye tests for liver function when applied to gross pathological changes in the presence of icterus. It is certain that the hepatic parenchyma is greatly damaged by long continued obstructive jaundice and retention of dye is therefore to be expected. In fact this retention persists in such cases long after obstruction of the common duct is relieved. In obstructive jaundice of short duration however, no very definite morphological changes can be demonstrated although dye tests may indicate maximal retention.

Rous and Drury have recently shown in experiments on animals that the liver is unable to take up the dye sodium indigotate after prolonged chloroform anaesthesia and that during this period of temporary dysfunction bilirubin is not secreted by the liver. They have further demonstrated that the dye is not absorbed by the liver within so short a time as 24 hours after ligation of the common duct. The interpretation of such findings is difficult, the possibility of functional impairment of the

hepatic cells, and likewise that of a chemical combination between the bilirubin and the dyes used or of their combination with some other substance must be considered.

In an effort to cast further light on the problem I have recently administered quantities of bile intravenously to dogs using amounts considerably less than the lethal dose. During the period of injection and for a short time thereafter there is a high percentage of retention of dye. Within 24 hours the normal hepatic function of excreting dye will be resumed. Serial sections taken during and after these injections show practically no demonstrable morphological change in the liver cells.

The experimental findings must be taken into account in the interpretation of tests involving the excretory function of the liver, particularly when jaundice is present. The clinical value of dye tests for hepatic function is unquestioned; the data presented are intended simply to call attention to certain of their known limitations. It is apparently not justifiable to reckon hepatic damage when produced by jaundice particularly if it be of the obstructive type in terms of retention of phenoltetrachlorophthalein alone; the clinical aspects of the case in question must be carefully reviewed. The analogy of diminished excretion of phenolsulphonephthalein and increased blood urea in prostatic obstruction may help to illustrate this point. One expects a rapid return to normal as the obstruction is relieved provided renal damage has not been too great. An entirely similar phenomenon is observed in cases of obstructive jaundice after drainage of the common duct is established. A failure of excretion of bile pigment after operation has almost exactly the same significance as a decreasing output of urine after prostatectomy.

In conclusion it may be said that our new knowledge of the physiology of the liver particularly that relating to jaundice has produced a definite improvement in the diagnosis and management of hepatic disease. Physiological and chemical knowledge relating to jaundice has been put to practical use. Much remains to be done along experimental lines: the fields of the metabolism of bile acid and cholesterol remaining practically un-

touched. The field for new tests for hepatic function and for a study of those already available with a view to their better interpretation is attracting the attention of investigators.

Difference of opinion between pathologists and clinicians has added to the general confusion regarding the classification of hepatic disease. It is encouraging to know that new classifications involving the more recent additions to our knowledge of the subject are in project. The general interest augurs well for a better understanding of one of the most complex and difficult fields of medicine.

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## APPENDICITIS IN INFANCY AND CHILDHOOD

By STANLEY J. SLIFER, M.D., F.A.C.S., MILWAUKEE, WISCONSIN

From Milwaukee Children's Hospital

FROM May 20, 1913, the earliest date from which accurate records are available to December 31, 1924, 8,973 patients were admitted to Milwaukee Children's Hospital. During this period 61 operations for appendicitis were performed. The cases were fairly equally divided among five surgeons who were on the active service at different periods. Five patients died, making the mortality for this series 8.2 per cent.

In the following table the 8,973 patients are grouped according to age, and the number of cases of appendicitis occurring in each yearly group is shown.

It will be noted in Table I that none of the patients with appendicitis was under 2 years of age. 12 were between the ages of 2 and 8 and 49 were between 8 and 13. Other series bear out this apparent rarity of appendicitis in infancy. Abt in 1917 could find only 80 cases in patients under two reported in the literature. Several reasons are advanced to explain the fact that appendicitis is rare in the first few years of life. It is thought that the liquid diet, the absence of hard fecal concretions and the frequency of bowel movements have some influence, as has the supine position in which the infant spends most of its time.

TABLE I.—PATIENTS ADMITTED TO MILWAUKEE CHILDREN'S HOSPITAL BETWEEN MAY 20, 1913, AND DECEMBER 31, 1924, AND NUMBER OF PATIENTS WITH APPENDICITIS IN VARIOUS AGE GROUPS

| Patients with appendicitis | Total | Patients admitted |
|----------------------------|-------|-------------------|
| Under 1 year               | 0     | 1354              |
| 1-2                        | 0     | 804               |
| 2-3                        | 1     | 539               |
| 3-4                        | 0     | 630               |
| 4-5                        | 3     | 508               |
| 5-6                        | 1     | 722               |
| 6-7                        | 4     | 40                |
| 7-8                        | 3     | 34                |
| 8-9                        | 11    | 752               |
| 9-10                       | 8     | 606               |
| 10-11                      | 9     | 539               |
| 11-12                      | 11    | 506               |
| 12-13                      | 10    | 359               |
| Total                      | 61    | 8973              |

It is usually stated that appendicitis is more common among boys than girls in the proportion of two to one. This relation is well demonstrated by our series as 41.67 per cent of our patients were males and 58.33 per cent were females. The statement is also frequently encountered that the mortality rate is twice as high among girls as boys. Of 5 patients who died 3 were girls and 2 were boys.

Certain characteristics of appendicitis in infancy and childhood are emphasized by all writers. Most important are the obscurity of the symptoms in early life with a gradual transition to the classical adult picture with increasing age, the rapidity of the course and the tendency to perforation with subsequent peritonitis.

In discussing the obscurity of symptoms Howard Kelly says: 'The abdomen of a little child is but a miniature of the adult in the relative approximation of all the organs and in the close contiguity of those in the pelvis and in the upper abdomen. The boundary lines of the abdomen are approximated. With age and the assumption of the adult form the organs are separated by a wider interval, their differentiation being thus facilitated.' Muller and Ravdin call attention to the fact that many writers erroneously state that the pain in appendicitis in children varies because of the variations in the position of the organ. The appendix receives its nerve supply during embryonic life from the abdominal sympathetic. The sensation of pain which attends the earliest stage of appendicitis is referred to the cutaneous distribution of the spinal nerves with which the sympathetic center makes its connections. As a rule therefore pain is referred to the region of the umbilicus, the terminal distribution of the tenth and eleventh intercostal nerves. As the inflammation spreads and the peritoneal coats and contiguous structures are involved the pain is felt in the right iliac fossa or wherever the appendix may be located. It is this second

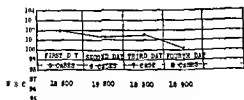


Chart showing average admission temperatures and blood counts of 26 patients with ruptured appendices. The number of days following onset of symptoms and the number of patients entering on that day are shown

ary pain which tells us the location of the appendix

It is common of many diseases in early life upper respiratory and intestinal infections for example to be ushered in by nausea vomiting fever and abdominal pain Vomiting occurred in 44 of our cases and was present in all but 3 of the 36 patients with ruptured appendices Constipation is a symptom of value in the diagnosis of appendicitis and when it is present in association with the foregoing symptoms appendicitis should be considered a probability McManus gives the rule that in patients over 4 with constipation other things being equal the condition is probably appendicitis while in patients under 4 with diarrhoea the condition is probably gastroenteritis Twenty four of our cases gave a history of constipation and only 6 a history of diarrhoea Pain on urination was noted in 10 cases

The average admission temperature of patients with acute appendicitis unruptured was 100.8 the average temperature of patients with ruptured appendices and a spreading peritonitis was 101 The maximum and minimum temperatures for acute appendicitis were 104 and 98.8 and for ruptured appendicitis were 104 and 98

The average leucocyte count for the entire series was 17 500 the average count in acute appendicitis unruptured was 15 500, the maximum and minimum counts being 5 100 and 9 800 The average leucocyte count in the acute cases ruptured was 19 000 the maximum and minimum being 39 600 and 11 200 It would seem from these figures that the leucocyte count is somewhat more reliable in indicating the degree of involvement than is the temperature and one is reminded of the statement of Zachery Cope that a normal

temperature does not mean a normal peritonium (Chart)

Fixation of the abdomen during respiration is a striking sign when there is a spreading peritonitis present Tenderness is difficult to interpret in many instances and it requires tact and patience to elicit this symptom in such a manner as to be satisfactory Rigidity of the abdominal muscles was noted in 45 of our cases and was not absent in any case in which the appendix was ruptured Because of the shallow pelvis of the child rectal examination reveals evidence of value much oftener than it does in the adult

The fulminating character of appendicitis in children is evidenced by the fact that in 36 of the 61 cases 59 per cent the appendices were ruptured The patients with ruptured appendices entered the hospital on the following days after the onset of symptoms

TABLE II — NUMBER OF DAYS AFTER ONSET OF SYMPTOMS CASES OF RUPTURED APPENDICES ENTERED

| Day  | First    | Second | Third      | Fourth     | Fifth | Sixth      | Seventh | Eighth    | Ninth | Tenth  | Eleventh | Twelfth | Thirteenth | Fourteenth   |
|--|----------|--------|------------|------------|-------|------------|---------|-----------|-------|--------|----------|---------|------------|--|
| Number of cases  | 5        | 6      | 8—one died | 7—one died | 1     | 2—one died | 1       | 1—abscess | 2     | 2—died | 0        | 0       | 0          | 3—one died general peritonitis two had localized abscesses |
| 4 weeks  |          |        |            |            |       |            |         |           |       |        |          |         |            | 2—abscess formation in both                                |
| Total  | <hr/> 36 |        |            |            |       |            |         |           |       |        |          |         |            |  |
| 11 30 per cent ruptured in the first 48 hours                              |          |        |            |            |       |            |         |           |       |        |          |         |            |  |
| 18 per cent of the entire series ruptured in the first 48 hours (61 cases) |          |        |            |            |       |            |         |           |       |        |          |         |            |  |

Eighteen per cent of the entire series had ruptured appendices in the first 48 hours and considering the cases with ruptured appendices as a group in 30 per cent rupture occurred in the first 48 hours The average entrance day for the cases of acute appendicitis with unruptured appendices was the second day while the cases of appendicitis with ruptured appendices entered the hospital on an average 3½ days following the onset of symptoms

It is a truism to say that in acute appendicitis in infants and children, the prognosis depends on proper and early diagnosis and prompt surgical intervention. In spite of the difficulties which have been enumerated, careful analyses of symptoms and signs leads to a surprisingly high percentage of correct diagnoses. In the treatment of appendicitis it has been the policy of the surgical section of this hospital to advise operation in all but obviously moribund patients. Even in desperate cases the results of operation have been at times most gratifying. In infants the omentum is a thin short transparent structure plainly not involved in the localization of infection. It gradually increases in size and length and in older children is occasionally seen near the appendix and at times is wrapped around it. The peritoneum in infancy and childhood is also less resistant to infection than in the adult. In children vomiting from intra abdominal disease dehydration is rapid and the general bodily reserve which may be utilized to combat infection is soon exhausted. In several instances children apparently in desperate condition have been transformed to hopeful cases in a few hours by operation. The change in the facial expression in some of these patients is especially striking. We believe that the expectant plan of treatment has an extremely limited field of application in appendicitis in infancy and childhood.

The cases here reported represent all cases of appendicitis seen at this hospital during the stated period with only three exceptions which are the following. Two patients, both girls aged 9 and 10, had mild attacks and were discharged from the hospital as improved. Operation was advised in both cases but was not done because the parents refused in one instance and because of severe illness in the family of the other. The third patient listed as appendicitis came to the hospital with a two day history of pain in the abdomen, vomiting and sore throat. The temperature on admission was 103.4 and there were rigidity and tenderness over the lower right abdomen. Within a few hours after admission a typical scarlet fever rash developed and the patient was sent to the isolation hospital.

TABLE III—MORTALITY RATES IN APPENDICITIS IN CHILDREN QUOTED BY VARIOUS AUTHORS

|                       | Per  | Cases |
|-----------------------|------|-------|
| Alexander             | 3    | 500   |
| Muller and Ravdin     | 6.8  | 58    |
| Beckman               | 7.9  |       |
| Simpson               | 14.7 | 34    |
| Mitchell              | 21   | 40    |
| Gray and Mitchell     | 15   | 1200  |
| Spreading peritonitis |      |       |
| †126 acute            |      |       |

Our mortality rate of 8.2 per cent reflects the improvement in treatment and diagnosis which is evident in more recent series. In 80 cases under 2 years of age collected by Abt in 1917 the mortality was over 50 per cent. Only 46 of these patients were operated on; the operative mortality being 30 per cent. The mortality rate among patients not operated on was over 90 per cent. The following mortality rates shown in Table III are representative of those in the recent literature.

It is to be noted that of our patients who died all had ruptured gangrenous appendix with spreading peritonitis. One death occurred on each of three service and two on one other. The earliest day of admission following the onset of symptoms in fatal cases was the third. One entered on the fourth day, one on the sixth day, one on the tenth day and one on the fourteenth day following the onset. The fact that no deaths occurred among the patients with ruptured appendices operated on prior to the third day is merely an added bit of evidence for early intervention. Our patients who died were all desperately sick and it is fair to assume that operation gave them their only chance for recovery. It is fair to assume also that several of the patients operated on after the first 48 hours and who recovered would have died but for operation. In other words, by refusing to operate on these desperately sick cases one may improve his operative mortality statistics but taking all cases of appendicitis entering a hospital as a group, fewer patients will be discharged alive and well if this policy is followed than by operating on all cases except those in *extremis*.

In addition to advocating operation in practically all cases we believe that the McBurney muscle splitting incision is not only the

incision of choice, but that it is a great factor in reducing intra abdominal manipulation and postoperative shock. Time is an important element in the operation and should be conserved by any means consistent with safety. This incision gives bloodless access to the peritoneal cavity in 1 to 2 minutes, and in closing the wound in serious cases a stitch or two suffices. The degree of operative shock is directly proportional to the amount of small intestine exposed and to the amount of trauma inflicted. It is not unusual when doing appendectomy through this incision to see only a small portion of the terminal ileum. In cases with ruptured appendices with spreading peritonitis the system of drainage which we employ consists of placing a large sized split rubber tube with gauze to the bottom of the pelvis and a cigarette drain to the right kidney fossa both through the original incision.

The importance of the subcutaneous administration of normal salt solution in the postoperative management of these cases cannot be overemphasized. The dehydration resulting from vomiting and abstinence from food and water causes young children to wilt rapidly. As a rule it is not practicable to administer continuous hypodermoclysis but several hundred cubic centimeters can be given repeatedly. We have found codeine to be an efficient and safe sedative and believe that it should be used in doses sufficient to relieve pain especially during the first 48 hours after operation. One of the most important and most serious postoperative complications is acute intestinal obstruction. When this occurs prompt intervention is imperative but one should guard against extensive operative procedures. The suture of a catheter into a

loop of distended bowel is frequently all that these patients will stand and fortunately this operation not only relieves the symptoms of obstruction but it is often unnecessary to do anything more.

#### SUMMARY

- 1 Appendicitis is rare in the first 2 years of life.
- 2 There is a tendency to early perforation in appendicitis occurring in children.
- 3 With few exceptions appendicitis in early life should be treated surgically at whatever stage the patient is seen.
- 4 The McBurney incision is the incision of choice because it gives rapid and bloodless access to the appendix and as a rule very little intra abdominal manipulation is required when this incision is used.
- 5 Dehydration is an important factor and should always be considered in the pre operative and postoperative management of these children. It is best combated by the subcutaneous administration of fluids.

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# ACQUIRED SUPPURATIVE DIVERTICULITIS WITH PYLEPHLEBITIS AND METASTATIC SUPPURATION IN THE LIVER

## REPORT OF A CASE

By SAMUEL F. KRAMER M.D. PERTH AMBOY NEW JERSEY AND  
WILLIAM ROBINSON M.D. SPOKANE WASHINGTON

**A**QUIRED diverticula have only recently received ample attention in the literature. The condition is quite uncommon although not rare and it is not so long ago that it was considered a mere pathological curiosity. Quite a large number of case reports have appeared in the past 25 years which have established the importance of the condition because of the secondary pathological processes which are apt to occur. As recently as 1917 Telling (3) was able to find only one case of metastatic suppuration secondary to diverticulitis which was recorded by Whyte (4). Whyte's case was one of suppurative diverticulitis with metastatic abscesses in the liver. Clinically and pathologically his case was practically similar to ours although he was unable to obtain a positive blood culture during life and necropsy failed to reveal gross evidences of pylephlebitis. In 1901 Foggie ( ) reported a case of abscess of the brain secondary to diverticulitis and at that time claimed that his case was the second on record of distant suppuration from this cause. Careful search of the literature since has failed to reveal any other similar case. It appears therefore that our case is the third on record of diverticulitis with metastatic suppuration and the first with pylephlebitis.

## INCIDENCE

In 13069 necropsies performed at the Dresden City Hospital Johns Hopkins Hospital Boston City Hospital and the Bender Hygienic Laboratories there were found 39 cases of congenital (Meckel's) diverticula 16 instances of acquired diverticula of the small intestine and 28 cases in the large gut. Diverticula are usually multiple and are found most frequently in the large bowel especially in the lower part of the descending colon and sigmoid flexure. The sacs occur on the side of the gut or close to the mesenteric attachment

although they are found on the convexity in rare instances. The size varies from mere macroscopic visibility to that of a hazelnut. They rarely attain a larger size since secondary pathological changes are very apt to supervene.

## ETIOLOGY

The question has arisen whether this condition is congenital or acquired. It appears very significant that no case has occurred in a child the lowest reported age being 22 years. Although the anatomical arrangement of the muscle fibers and connective tissue of the vessel spaces furnishes a predisposing factor it appears likely that the condition is acquired. The average age is about 60 years and the occurrence is about twice as frequent in males. Because of the presence of fatty tissue in the bowel wall obesity may be a factor. The physiological role of the sigmoid with its retention of fecal matter and gas is stated to be important as is muscular deficiency of the gut wall associated with constipation and flatulence. It is evident that the spots where the gut is pierced by the vessels are areas of weakened resistance to internal pressure. Vascular dilatation incident to passive congestion of heart failure may further weaken the vessel spaces by pushing aside the muscle fibers. It is probable that no one factor is sufficient but that several or all co-exist.

## PATHOLOGY

There is no trouble until secondary pathological changes occur. The first tendency is toward progressive enlargement of the sac which leads early to atrophy of the muscle layers and the glands of the mucosa. The irritation of the contained hardened feces results in dangerous thinning of the sac and inflammatory changes which may be slight or may lead to serious acute or chronic lesions. Acute gangrenous inflammation of diverticula

has of course been described as has acute peritonitis of a general or localized nature. When perforation occurs the results depend on the acuteness of the ulcerative process, the amount of chronic inflammatory thickening and the presence of adhesions. Chronic proliferative inflammation of the submucous and serous coats of the bowel may lead to tumor formation and stenosis with obstruction. This chronic sigmoiditis resembles carcinoma clinically and pathologically and has undoubtedly been mistaken for malignancy by surgeons at operation and by pathologists at necropsy. The protective adhesions which may be formed in the course of slow inflammation may involve the small bowel giving rise to acute or chronic intestinal obstruction. On the other hand they may become attached to the bladder with the formation of a vesicocolic fistula. Chronic sigmoid mesenteritis with much inflammatory thickening may give rise to twists, kinks or volvulus. Lodgment of foreign bodies within the diverticula, carcinoma secondary to diverticulitis, perforation into a hernial sac and metastatic suppuration have also been reported.

#### SYMPTOMS

The clinical manifestations based on the foregoing pathological survey must necessarily be very varied. Many cases are identical with an acute appendicitis except that the trouble is on the left side. Left sided tumor and abscess formation are striking features. Some cases are found to have intestinal obstruction in any of the various forms. These are often confused with carcinoma even after the abdomen is opened when of course the recognition of the true pathology is of great importance. Perforative peritonitis or vesicocolic fistula may be the clinical findings with no suspicion of diverticulitis as the underlying cause. Our case is an example of metastatic suppuration in which no thought of diverticulitis was entertained.

#### DIAGNOSIS

The diagnosis is very difficult and is rarely made. Since the appreciation of the incidence and possible occurrence of a lesion is necessary for its diagnosis, diverticulitis must be borne

in mind by every surgeon who attempts to diagnose and treat abdominal lesions. If the surgeon recognizes the varied pathological pictures and remembers that the condition may resemble clinically almost any acute or chronic condition in the abdomen, many lives will be saved.

#### TREATMENT

The treatment is of course surgical and the procedure will depend entirely upon the pathological form which is encountered. If an abscess is found it must be drained and the opening in the bowel closed. If the bladder is involved in a vesicocolic fistula, the organs must be separated and closed by the usual methods. An intestinal obstruction caused by stenosis of the bowel may be relieved by inguinal colostomy when more extensive procedures are contra-indicated by the patient's condition. Resection of the sclerosed and stenosed gut may be performed on patients in good condition. In 1915 Beer (1) attempted to treat a case of pylephlebitis by ligation of the portal vein after an attempt to insure adequate collateral circulation by omentopexy and anastomosis between the left spermatic vein and branches of the inferior mesenteric vein. Some such heroic measure would have been necessary in the surgical treatment of our case.

C. H., a colored male, age 63 years, was admitted to the Cook County Hospital April 22, 1925, on the medical service of Dr. J. G. Carr. The patient stated that he was in good health and free from any complaint until 12 days before admission when he was suddenly seized with a severe chill lasting about 20 minutes. This was followed by the onset of nausea and vomiting which occurred 7 or 8 times that day. Pain in the upper right quadrant of a dull aching, sickening quality, intermittent in character and with no tendency to radiation was noted at the onset. In the days following there were frequent chills associated with fever. The pain continued but was never very severe. Vomiting and nausea did not recur after the first day. Jaundice was not noted by the patient although the color of the urine was dark. The color of the stools was not noticed since constipation was marked during the entire period. Weakness and prostration became more marked as time passed. The patient denied any previous attacks of a similar nature.

The inventory of systems failed to reveal symptoms of a nervous, respiratory or cardiovascular character. Nocturia and occasional dysuria had been noted for the past year.

The past history revealed a chancre 30 years ago for which numerous courses of antiluetic treatment had been given. A cataract was removed from the left eye about 3 years previous to entrance. The patient denied excesses of any kind.

The physical examination revealed an elderly well nourished oego male acutely ill and quite markedly prostrated. The skin had a peculiar yellowish brown color and there was definite icterus of the sclera and buccal mucosa. The pupils were small and equal in size but the left eye had an old iridectomy scar. The heart and lungs were normal. There was no evidence of free fluid in the peritoneal cavity. The liver was enlarged and was palpated three finger breadths below the costal margin. Marked tenderness and considerable voluntary muscle resistance were present over this area. The remainder of the abdomen was soft and free from any of the signs of peritonitis. No other organs or masses were palpated.

The blood pressure was 121-75. The blood count showed 17,000 to 19,000 leucocytes during the stay in the hospital. The urine was negative except for the presence of bile. Examination of the blood showed urea nitrogen 24.28 milligrams per 100 millimeters, uric acid 2.57 milligrams per 100 millimeters, creatinine 1.75 milligrams per 100 millimeters. Blood culture April 23, 1925 showed streptococcus viridans. Wassermann reaction was negative.

X ray of the gall bladder region revealed the liver to be enlarged. No shadows of a positive significance were seen in the right hypochondrium.

When admitted to the hospital the temperature was 101 degrees. Subsequently it remained normal or subnormal except for a terminal rise to 99.4. The pulse varied between 80 and 120. The patient continued to grow worse during the next week and 2 days before death sank into a condition resembling cholera.

*Extract of autopsy record.* The peritoneal surfaces are smooth and glistening. There is no peritoneal fluid. The appendix and gall bladder are grossly unaltered except for a few adhesions about the former. There is no obstruction in the common or hepatic bile ducts.

The liver is somewhat enlarged and the edges rounded. The surface has mottled areas resembling small subcapsular abscesses. On cut section the portal radicals large and small are filled with thick grey brown pus. There are numerous solitary abscesses in the liver tissue especially about the porta hepatis and the lower margin. The portal vein just before its entrance into the liver is filled with thick pus which is found in all its tributaries from the intestines particularly in the inferior mesenteric vein draining the large bowel.

The lower bowel especially the descending colon and sigmoid shows along the mesenteric border numerous diverticula filled with fecal material. In several areas these diverticula are occluded and suppurating. In connection with these large dissecting abscesses are found in the wall of the large bowel some of which communicate with branches of the mesenteric veins. There are no evidences of dilated or thrombosed hemorrhoidal veins.

*Anatomic diagnosis.* Multiple fecal impacted diverticula of the colon and sigmoid suppurative diverticulitis with huge intramural abscesses of the colon and sigmoid suppurative phlebitis of the mesenteric splenic and portal veins suppurative hepatitis and cholangitis multiple abscesses of the liver icterus gravis etc.

This case in retrospect presented a typical picture of pylophlebitis. All the cardinal symptoms were present such as chills pain in the hepatic region change in liver dullness jaundice picture of marked toxæmia absence of signs and symptoms of extensive peritonitis leucocytosis and positive blood culture. However appendicitis or hemorrhoids were never even suggested in the history or findings. It was evident that the patient had a septicæmia and there was every suspicion of suppuration within the liver but because of the absence of evidence of an intestinal lesion it was believed that the infection a virulent suppurative cholangitis was probably secondary to cholecystitis.

Pylophlebitis as a complication of neglected appendicitis is not a rare occurrence. It is probable that in the future more cases of multiple abscesses of the liver will be traced to diverticulitis. It also would follow that additional cases of pylophlebitis secondary to diverticulitis will appear in the literature since it is a very logical sequence of neglected typhlitis.

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## GLYCOSURIA AND PREGNANCY

BY HENRY J. JOHN, M.D., CLEVELAND, OHIO  
Cleveland Clinic

**G**LYCOSURIA is frequently found during pregnancy. It means sometimes that the patient is a diabetic but usually it signifies only a temporary or an insignificant condition. In the first instance treatment is indicated in the second no treatment is required. The condition should never be disregarded however until it has been definitely determined whether or not it is of diabetic or of innocent origin.

Two cases taken from a larger series will be sufficient to illustrate the problem presented by the presence of glycosuria in pregnancy and the necessary steps for differentiating innocent from diabetic glycosuria.

**CASE I:** The patient was a young married woman 24 years of age who consulted me because of the presence of sugar in the urine. There was no family history of diabetes. During childhood the patient had had measles, diphtheria and scarlet fever. She had been married 6 years and had two children the youngest being 3 months old. During her last pregnancy her obstetrician had found sugar in the urine about a month before parturition but the patient was told that it might be milk sugar and no further attention was paid to the circumstance.

During the 6 months since parturition the patient had had no special symptoms until a week before she consulted me when she began to have excessive thirst and frequency of urination. She consulted her family physician who found a marked glycosuria and prescribed a diet which she had followed for the 3 days before I saw her. At this time her fasting blood sugar was 107 milligrams per 100 cubic centimeters of blood. There was a slight trace of acetone and the sugar content of the urine was 1 plus. Although her blood sugar was normal when I first saw her in view of the fact that the patient had had glycosuria just before parturition and had so recently shown definite clinical signs of diabetes I advised a glucose tolerance estimation which was performed on the following day. The characteristic blood sugar curve of diabetes as obtained as is shown on the chart (Fig. 1 Case I). It will be noted that the fasting blood sugar on this date was 167 milligrams per 100 cubic centimeters of blood whereas the day before it was only 107 milligrams per 100 cubic centimeters of blood. The morning urine on the day of the glucose tolerance test showed only a trace of sugar whereas on the preceding day although the blood sugar content was lower the urine sugar was one plus (+). During the glucose tolerance test the pa-

tient took in 100 grams of glucose and excreted in the urine 16.76 grams.

The practical points illustrated by this case are the following. When glycosuria is discovered during pregnancy it may be and often is a sign of the initiation of the diabetic status when the earliest changes—the hydropic degeneration of the beta cells of the islands of Langerhans—are taking place. If the condition is cared for at this stage, the patient stands a good chance of recovery of a restoration of the islands to a normal or nearly normal status, as Copp and Barclay have shown by their work with dogs at the Physiologic Institute(2). These investigators undertook to discover the conditions under which the cells of the islands of Langerhans would regenerate. To this end they ablated about four fifths of the pancreas in each of a group of dogs and let the wound heal thus rendering the dogs

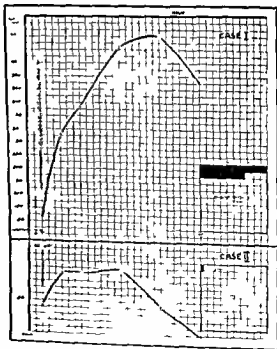


Fig. 1. Chart showing blood sugar curves in Cases I and 2.

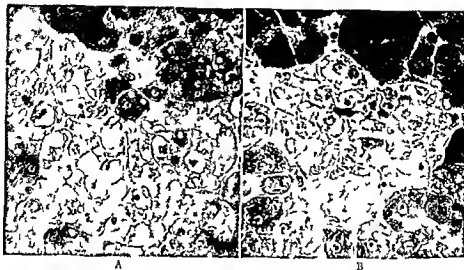


FIG. 2 Photomicrographs of excised pancreas (dog) showing: A, hydropic degeneration of the beta cells; B, restoration of cells of islets of Langerhans. (From Copp and Barclay.)

potentially diabetic. As long as these dogs were kept on a regulated diet, there was sugar in the urine and the blood sugar level remained normal. But when these potentially diabetic dogs were overfed, the blood sugar increased and the dogs began to excrete large quantities of sugar in the urine and to show the signs of general physical failure such as are exhibited by uncontrolled diabetic patients. After the animals had been subjected to this overfeeding for from 7 to 9 weeks, the authors excised a piece of the pancreas in which they were able to demonstrate the hydropic degeneration of the beta cells (Fig. 2 A).

The dogs were then placed on proper diet and insulin was administered. The urine promptly became sugar free and the blood sugar normal. After they had been subjected to this controlled regimen for from 7 to 9 weeks, again a portion of the pancreas was excised and examined and the cells of the islets of Langerhans were found to be restored (Fig. 2 B).

These findings provide a concrete demonstration of what we have repeatedly seen clinically, that is, that when diabetes is treated early in its development, there is a good chance of restoration of the insulogenic function, but if the treatment is postponed until

the islands are gone—fibrosed—nothing will bring about their regeneration.

It is for this reason that when glycosuria occurs during pregnancy, it should never be ignored as a chance occurrence as due perhaps to sugar of milk, but the patient should be subjected to a rigid examination to determine the exact status.

As a rule, the diagnosis is quickly and easily made except in borderline cases, by making a blood sugar estimation 2½ hours after a heavy meal of carbohydrates. If this blood sugar value is 160 milligrams per 100 cubic centimeters of blood or more, we can safely say that we are dealing with a diabetic patient in whom, however, the condition may clear up after parturition, provided the condition is properly controlled in the meantime. On the other hand, if the blood sugar estimation in the above test is 90 milligrams per 100 cubic centimeters of blood or less, then we may know definitely that we are dealing with the renal type of glycosuria, which requires no treatment.

**CASE.** This patient was a young married woman 24 years of age, who was in the third month of her first pregnancy. There was no familial history of diabetes. During childhood she had had measles, mumps, chickenpox, diphtheria, and whooping cough, and later in life tonsillitis, grippe, and pleurisy. Ten years before a tonsillectomy had

been performed and an appendectomy 7 years before.

The patient had been referred to me by her obstetrician who 2 weeks before had found sugar in her urine. The frequency of urination had been increasing so that when I first saw her she had to get up every 2 hours during the night. When I first saw her her fasting blood sugar was 73 milligrams per 100 cubic centimeters of blood and there was no glycosuria. Three days later I made a glucose tolerance test the results of which are illustrated in the chart (Fig. 1 Case 2). This normal curve shows that we were dealing with a patient with a low renal threshold for sugar for although the highest blood sugar excursion was 138 milligrams per 100 cubic centimeters of blood glycosuria was present at the end of the first and again at the end of the second hour. The total output of sugar was but 0.47 grams in marked contrast to the output of the first patient.

The two cases here described show the two contrasting findings in cases in which glycosuria is present in pregnancy. They show that the glycosuria in itself is but a symptom and

is not of final diagnostic significance but that it calls for further investigation. The first case required treatment for diabetes while the second case did not require such treatment. On the one hand to disregard the presence of sugar in the urine in such cases might mean that the patient would be deprived of a vitally needed protection and on the other to subject every such patient to the routine treatment for diabetes might mean a dietary restriction and a psychic strain which the patient could and should be spared.

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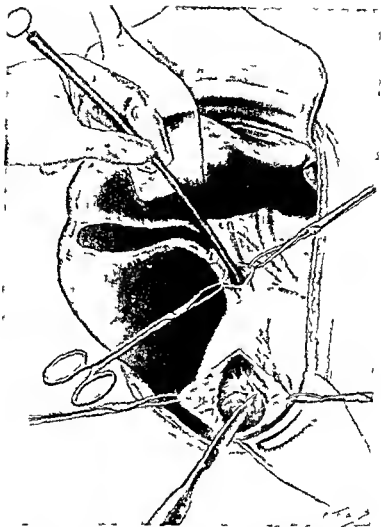


Fig. 5. If there is a calculus in the ampulla of Vater obstruction of the papilla the duodenum is opened. The papilla may be incised for the extraction of the calculus or the passage of the drain.

# CLINICAL SURGERY

## FROM THE CLINIC OF PROFESSOR PIERRE DUVAL INTERNAL DRAINAGE OF THE COMMON BILE DUCT<sup>1</sup>

By J. GATELLIER, PARIS, FRANCE  
Assistant Surgeon, Hôpital de la Pitié

THE great majority of surgeons institute external drainage of bile after opening the common duct. While drainage of the biliary passage is a measure of necessity yet it seems illogical to establish external drainage for if the flow of bile is directed toward the duodenum it is a much more physiological procedure as the bile then follows its natural course. For this reason Professor Pierre Duval considers internal drainage the procedure of choice and believes that it should replace external drainage with the T tube.

### DISADVANTAGES OF EXTERNAL DRAINAGE

The principal disadvantages of external drainage are the following:

a. The necessity of packing the liver bed with gauze, the slowness in healing of the abdominal incision facilitating the formation of postoperative hernia and the forming of perityphloic and periduodenal adhesions which may result in stenosis and cause late digestive troubles.

b. The absence of bile in the duodenum. Although loss of bile through external drainage is only temporary and incomplete yet there is enough loss to cause disturbance in the digestion of fats and an insufficient utilization of them. The absence of bile is unphysiological. Patients suffering from liver disease are especially in need of all their biological resources to aid in rapid convalescence. The loss of weight and the almost cachectic appearance of patients suffering from a prolonged loss of bile are well known.

Certainly the ideal operation would be choledochotomy followed by immediate suture of the common duct. However this procedure is not free from untoward and some times very serious results. Dilatation of the papilla to assure permanent drainage toward the duodenum as advised by Moynihan seems to be more effective theoretically than practically. As to the choledochoduodenostomy although successful this

operation has proved to be more dangerous than has duodenal drainage.

### PRE-OPERATIVE PREPARATION OF PATIENTS

Patients suffering from obstructive jaundice are subjected to the same type of examination as are patients suffering with all liver diseases and are prepared for operation accordingly. These preparations include tests to determine the blood urea, blood sugar, the quality of blood and coagulation and bleeding time. An attempt is made to restore as far as possible the biological equilibrium to regulate the urea level by dietetic measures, to restore normal coagulation and bleeding time by intravenous injections of calcium chloride. Subcutaneous injections of liver extracts are made to furnish a momentary compensation for the functional insufficiency of the liver. Rectal drips of saline with glucose are given in quantities of 1,500 cubic centimeters daily.

The benefit of complete rest—absolute relaxation—should be given to the patient before operation. Enemata are given to empty the bowels thoroughly. Whether jaundiced or not the patient should be operated on when the fever has subsided. Naturally internal drainage can be applied only when none or hardly any infection is present in the biliary tract or if a sufficiently long period has elapsed since the last flare up. In the presence of septic cholangitis external drainage should be done.

Careful roentgenographic examination should be made not only to confirm the diagnosis of stone in the gall bladder and common duct but also to detect any possible abnormalities in the



Fig. 1. Drain with fenestrated metallic tube and stylette for transvateran drainage of the common duct.



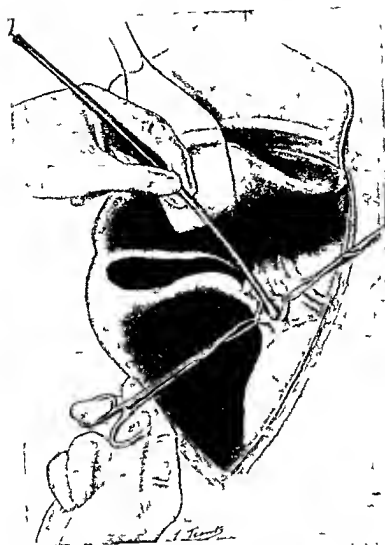


Fig 2 Cholecystectomy ligation of the cystic duct supraduodenal cholecystotomy The drainage tube is introduced into the common duct

duodenal passage. A duodenal stenosis below the papilla of Vater certainly contra indicates internal drainage.

#### TECHNIQUE

The technique used by Professor Pierre Duval was recently described in detail.<sup>1</sup>

**Incision.** Professor Duval does not use the Kehr or Sprengel incision. He prefers to enter

the abdominal cavity through a vertical incision which is made at the external third of the rectus muscle and bends slightly at the upper angle toward the midline (Mayo-Robson).

After cholecystectomy and ligation of the cystic duct a vertical supraduodenal incision is made in the common duct. The duct is probed through this incision with urethral sound. The papilla is gradually dilated up to the size of a No. 20 bougie. This catheterization is usually very easy. It can be readily noted the momen-



Fig 3 With the aid of the olivary tube the drain has passed the papilla and entered the duodenum. With the index finger the rigid tube can be palpated through the anterolateral wall of the intestine.

the papilla is dilated sufficiently and the sound passes into the duodenum.

At this stage the drainage tube is inserted. This drain (Fig 1) is made of rubber and has a metal perforated tip. A metal stylette may be inserted to make the tube rigid.

With the right index finger we lift up the common duct and push the tube in through the opening (Fig 2). Gradually the sound is pushed in until finally the metal tip disappears behind the pancreas. We then place the right hand on the duodenum and palpate the tip as it enters the bowel. First the metal tip then the rubber tube passes the papilla. The tube within the papilla produces a circular band which is easily felt. The metal tip can be palpated through the duodenum and when it is well in place the stylette is removed (Fig 3).

It is advisable to insert the tip of the drain as far as the third portion of the duodenum. The rubber part is cut long enough so that a small section may be left in the hepatic duct. The common duct is now completely closed (Fig 4). The liver bed and cystic stump are covered with peritoneum. A rubber drain is placed under the liver exceptionally closure without drainage can be done.

It is well to note that in certain cases in spite of the preliminary dilatation and the presence of a metal tip the tube becomes stuck at the papilla, curls up and cannot be made to pass the obstacle. If this occurs the duodenum is opened (Fig 5). The papilla is then dilated under direct vision and may even be incised if necessary. The sound is grasped with a forceps from the duodenum and drawn into its lumen. The duodenum is

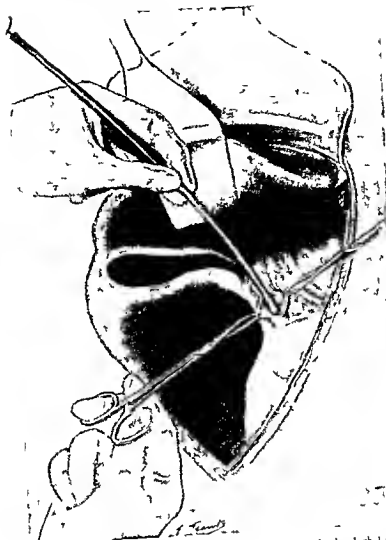


Fig. 2. Cholecystectomy, ligation of the cystic duct, supraduodenal cholangiotomy. The drainage tube is introduced into the common duct.

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<sup>1</sup> D. J. P. et Rich. d. A. Le d. E. d. J. L. tr. 1. 9.  
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FROM THE OBSTETRICAL CLINIC OF THE LONG ISLAND COLLEGE HOSPITAL

## TECHNIQUE OF TRANSPERITONEAL CÆSAREAN SECTION

By JOHN OSBORN POLAK MD FACS BROOKLYN  
Professor of Obstetrics and Gynecology, Long Island College Hospital

WHILE it is an admitted fact that throughout this country too many cesarean sections are being done it is likewise true that in many of the conservative clinics too few have been done. At times because of the delay necessary to give the woman a test of labor this conservatism has cost not only the life of the child but because of the consequent starvation and exhaustion incident to this test has contributed to the high maternal morbidity and mortality attending late section.

After a woman has become exhausted a condition which is evidenced by her restlessness, rise in pulse and temperature, molding of the uterus and gaseous distention of the abdomen, section is fraught with great danger. However, this danger may be minimized by the following steps which are employed as routine in our clinic in handling cases of dystocia.

1. Pelvic disproportion or fetal malposition should be recognized either before or immediately at the beginning of labor. This presupposes some prepartal study, as for instance, the determination of the size of the pelvis, the relative size and position of the head, its malleability, the inclination of the brim and the axis and direction of the uterine drive.

These points are readily recognized in the case of actual contraction. It is, however, the

borderline case in which there is but slight disproportion with perhaps nothing but slight deflexion of the vertex that requires the greatest obstetric judgment. Since over 80 per cent of labors in borderline contractions terminate spontaneously or by the aid of low forceps it is well in these cases to allow the woman to have a moderate test of labor—this is best given in bed, conserving her strength by rest, the free use of morphine and scopolamine, forced feeding and the forced in-

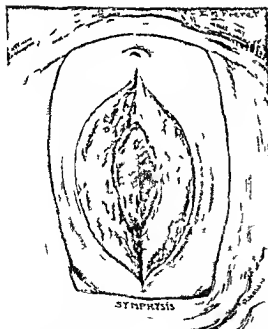


Fig. 1. A median incision is made through the skin and rectus fascia showing dusky peritoneum over pregnant uterus.

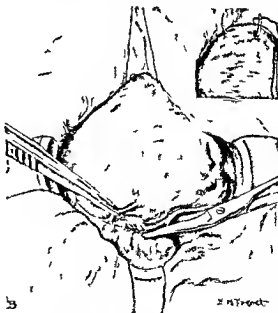


Fig. 2. A Traction stitch. B Separating bladder reflection. Incision walled off with gauze packs. This case had a very low bladder attachment.



Fig. 4 The upper end of the drain is passed upward into the common hepatic duct. Suture of the common duct.

closed in two layers. This interference is stood perfectly by the patient. In four such cases of Professor Pierre Duval's uneventful recoveries were observed.

#### POSTOPERATIVE COURSE

The postoperative course is generally undisturbed. A slight escape of bile may be noted through the external tube for the first few days.

This tube is ordinarily removed on the fifth or sixth day.

It is advisable to inject liver extracts daily and to administer per rectum 1,500 cubic centimeters of saline with sugar. The duodenal tube is tolerated astonishingly well. Because of the metal tip evacuation of the tube throughout the intestinal canal can be observed under X-ray. The earliest discharge has been observed on the forty-fourth day. In some cases a much longer time was required. No accident has been noted during the progress of elimination.

When patient is discharged from the hospital the loss of weight has varied from 2.2 kilograms to 5.4 kilograms. Convalescence is remarkably uneventful.

The notable features of this procedure are the formation of a perfect scar, the absence of hernia formation and of fistula, and the excellent condition of the patient.

#### SUMMARY

Since April 6, 1924, to January 15, 1926, 41 choledochotomies have been performed in this clinic. Out of these, in 16 duodenal drainage was used, while in 25 external drainage was used. In the 16 cases of duodenal drainage, 1 death occurred. This was due to lobar pneumonia during an epidemic of influenza. The remaining 15 cases made complete recoveries.

The two main advantages of this method are rapidity of recovery and good end results. Professor Pierre Duval considers this procedure the method of choice in cases of biliary retention which are not or only slightly infected and are in the stage of quiescence.

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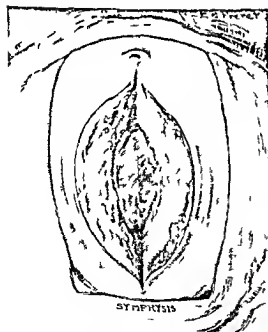


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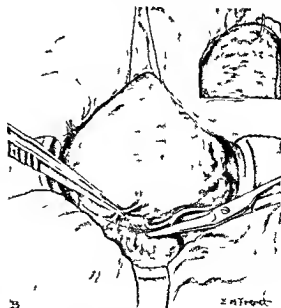


Fig. 2. A Traction stitch B Separating bladder from uterus. Incision walled off with gauze packs. This case had a very low bladder attachment.

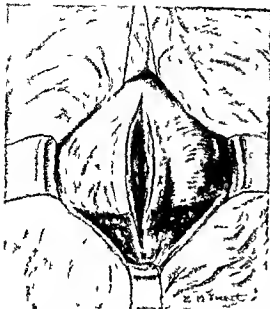


Fig. 3. Bladder retracted downward. Incision through uterine wall.

gestion of fluids. During this preliminary test the character of the contraction, the contour of the uterus, the pulse, temperature and progress in descent and amount of dilatation are carefully checked. Should there be no evidence of advance as is shown by the arrest of the presenting part or no apparent gain in the amount of dilatation of the cervix a careful vaginal examination with the bladder empty should be done and an attempt made to crowd the perfectly flexed head into the brim. If there is much overriding or if the consistency of the head and sutures show that it cannot be crowded in, the case should be subjected to section.

#### PRE-OPERATIVE PREPARATION

The patient to be sectioned should have a short period at least of pre-operative physical and mental rest. This may be secured by giving her  $\frac{1}{6}$  grain of morphine and  $\frac{1}{200}$  of a grain of scopolamine three quarters of an hour to an hour before the time set for operation, and if she has been subjected to a test of labor as above described she should also have an intravenous injection of 250 cubic centimeters of a 10 per cent glucose solution prior to anesthesia. Morphine and glucose preserve tissue waste.

After the vulva has been clipped of its hair and the vulva and inner surfaces of the thighs have been thoroughly washed with soap and

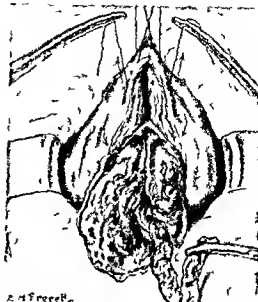


Fig. 4. First row of sutures through uterine muscle rolling edges together and helping to express placenta.

water 1 ounce of a 4 per cent solution of mercurochrome should be slowly injected into the vagina while the patient has her hips elevated on a sterile douche pan. This should be done at least 30 minutes before she is sectioned and is particularly necessary when the membranes are ruptured. The vulva and inner surfaces of the thighs should also be painted with this solution. The woman is then catheterized and the abdomen prepared in the usual manner with a 3½ per cent iodine solution which is applied over the entire skin surface of the abdomen from the ensiform to the pubis and is allowed to dry. Local anesthesia supplemented with gas oxygen gives sufficient relaxation.

#### OPERATION

The patient is now draped with sterile towels and a median incision below the umbilicus is made through the skin and fat, exposing the anterior sheath of the rectus muscle. Another knife is now employed to incise the fascia as near the median line as possible. The fascia is opened to the full length of the wound which allows the rectus muscle to be displaced outward and the posterior sheath of fascia with the attached peritoneum grasped between two Kelly clamps and divided. This incision in the posterior fascia and peritoneum is also extended to the full limit of the wound. This exposes the lower segment of

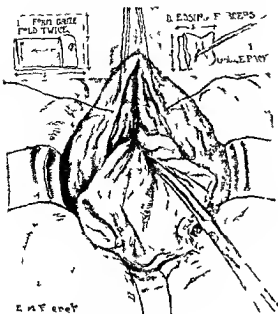


Fig 5 Iodoform gauze is packed into the contracting uterus

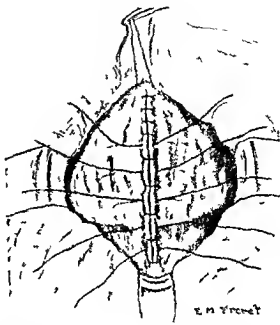


Fig 6 First row of sutures tied. Second row of sutures in place

the uterus with the bladder carried up to about the middle of the wound (Fig 1). The wound edges are now protected with wet gauze towels and retracted with retractors—a traction suture passed through the uterus and grasped with forceps holds the uterus taut against the anterior abdominal wall (Fig 2). The bladder reflection of peritoneum is now sought near one round ligament and picked up with tissue forceps incised with a pair of curved Mayo scissors which are passed beneath the uterovesical fold and spread to separate it—thus allows the superficial layer of peritoneum to be cut across (Fig 2) care being taken not to get into the deeper tissues and so traumatize the superficial veins. The bladder is then detached by blunt dissection as in hysterectomy and retracted with a Deaver retractor. With traction on the traction suture above and retraction with the Deaver retractor below the uterus may be readily incised with little or no bleeding unless the placenta happens to be under the uterine incision (Fig 3). Care must be taken to make the uterine incision of sufficient length to permit of the easy expulsion of the head by pressure from above upon the uterus through the abdominal walls—or with the Zehner lither which slides it out by a shoe horn action.

It is best when possible to deliver the child by the head for podalic version and extraction are

apt to extend the incision in the uterus and cause irregular tears of the uterine muscle. When the child is delivered the cord is clamped in two places by an assistant and cut between clamps.

The traction suture at the upper angle of the wound holds the uterus against the abdominal wall and prevents any eversion of the intestines. The uterine wound is now sutured the suture beginning at the upper angle. No 2 chromic catgut is used on a Hagerdorn needle. Each suture in the upper third of the wound passes through the serosa the entire thickness of the uterine muscle on the one side just skipping the endometrium and through the muscularis and serosa on the opposite side. Of course in the lower two-thirds only the muscle is included in the suture. These sutures are placed at half inch intervals. Their ends are clamped and held.

The time consumed in placing the sutures allows the uterus to contract and retract and separate the placenta (Fig 4). In clean cases we have found it best to allow the placenta to separate spontaneously and then after its removal to pack the cavity of the uterus with washed iodoform gauze (Fig 5) leaving the gauze *in situ* to be delivered through the cervix by uterine contraction. After the placenta is delivered and the gauze inserted the sutures already *in situ* are tied and closure of the uterus is completed by placing superficial sutures



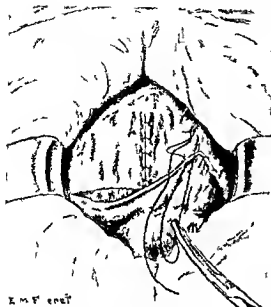


Fig. 6 Bladder peritoneum sutured over uterine wound. Downward pull of anterior face of uterus by traction on sutures.

through the muscularis and serosa and through the muscularis alone between each of the deeper sutures. In the upper third of the wound this causes a slight infolding of the edges of the serosa (Fig. 6). When the uterine wound is closed and the ends of the sutures cut short the wound is covered with the bladder reflection. This is done with a continuous suture which is begun at one round ligament and is finished at the opposite round ligament, the peritoneal flap being carried across the front of the uterus covering the uterine wound (Fig. 7).

It has been our custom to add to the safety of this exclusion by making a second line of sutures which infolds the first and effectually seals the uterine wound from the possibility of peritoneal leakage. It is immaterial when there is sufficient bladder flap whether we make the upper peritoneal flap as suggested by Beck or not.

In potentially infected cases in which the membranes have been ruptured for a long time and the cervix is fully dilated the placenta after it has separated may be expressed through the cervix into the vagina as in the normal case by simply making traction on the untied sutures which have been placed in the uterine wound thus closing it at the same time that the Crede maneuver is used. The uterus is then packed through the uterine wound as already described

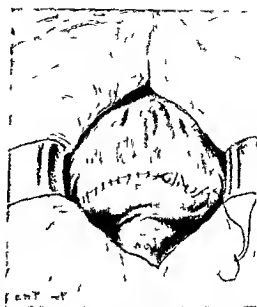


Fig. 8 Uterine wound completely covered and in apposition with bladder. The return suture has been nearly completed.

and the sutures tied and cut. The subsequent exclusion of the wound is carried on as in the relatively clean case.

Remember that we do not claim that the transperitoneal section can replace the Porro operation in infected cases rather that it has advantages over the classical operation and should be more generally used. If this operation is properly done the finished result is shown in Figure 8. The uterine wound is completely excluded, no intestines have been seen and no areas soiled from the uterine spill.

The abdominal wound is then closed in the usual manner, peritoneum to peritoneum, fascia to fascia, muscle to muscle, while the anterior fascia is closed with a chain suture of chromic catgut. The skin is closed with clips or a running silk suture. The wound dressing consists of a layer of perforated oil silk and two thicknesses of 4 by 8 gauze.

#### AFTER TREATMENT

The after treatment of these patients should be as follows. After the woman has reacted she is placed in a moderate Fowler position with a Harris drip. She is given a course of ergot and pituitrin, one ampule of pituitrin immediately upon closing the uterine wound and 15 minims of ergotol every hour for 6 hours after her return

from the operating room. The other treatment consists of routine morphine in  $\frac{1}{12}$  grain doses every 4 hours for the first 24 hours, water on the cessation of vomiting and a soft diet after the first 36 hours.

#### POINTS TO BE EMPHASIZED

The points that are important in this technique and need to be emphasized are: first the low abdominal incision. Second the placing of the traction suture in the uterus at the upper limit of the abdominal incision which when held taut

makes a perfect occlusion of the wound. Third, the separation of the peritoneal flap including the bladder. Fourth the delivery of the fetus by the head. Fifth the allowing of the placenta to separate spontaneously. Sixth the packing of the uterus with washed iodoform gauze to stimulate its contraction and retraction. This gauze is usually found in the vagina at the end of 24 hours. Seventh the complete occlusion of the uterine wound by the suture of the bladder reflexion over it which prevents the possibility of peritoneal leakage and intestinal adhesions.

A RATIONAL MANAGEMENT OF SKIN GRAFTS<sup>1</sup>

By FERRIS SMITH A.B. M.D. F.A.C.S. GRAND RAPIDS, MICHIGAN

Fifth Con. d.R. and Cl. W.

IT IS interesting to note that one of the oldest useful procedures known to surgery could pass through 60 years of frequent application without any accurate or rational basis for its total technique. One has reason to believe that the art of skin grafting is among the earliest of surgical accomplishments as it was used by the Kooman priests for rhinoplasty two thousand years ago. Between that time and the work of Riverdin in 1869 little if any, and certainly no scientific attention was paid to the subject. It remained for Riverdin to re-demonstrate the parasitic quality of skin and to point out its value to surgery. He enunciated certain rules for procedure both in the procuring and the application of the skin but he did not stimulate any interest in why it grew nor how it grew nor did he take the next step to determine why larger pieces of skin did not grow in a similar manner.

Stimulation in this work resulted in very valuable contributions by Ollier of Lyons and J. R. Wolfe of Glasgow in 1872. To Thiersch of Leipzig belongs the credit of perfecting and popularizing the work of Ollier and to Fedor Krause the credit for important modifications of the method of Wolfe. Meanwhile there have been innumerable experiments some fantastic and many of them sound with skin from various sources used under various conditions. The majority of workers agree upon the certainty and widespread application of the Thiersch method but the number of opinions as to the essentials of success with the full thickness graft of Wolfe is limited only by the number of operators. It is this lack of any scientific basis for procedure that has produced such varying reports of success and convinced some operators that only small grafts of this type should be attempted. Successful Wolfe grafting is essential to the facial surgeon and extremely important in plastic procedures on other parts of the body.

Only two types of auto and iso grafts the full thickness graft of Wolfe Krause and the split skin of Ollier Thiersch merit our attention the third type the zoograft being too spectacular and too unnecessary to deserve serious consideration.

There is a wide difference of opinion as to the source of the grafts. It is universally conceded that the autograft is the type of choice but it is

held by some authors that none other will succeed. McWilliams states in a recent article that he has never had any success with isografts and believes that the reports of success with this type of grafts may be relegated to mythology. On the contrary Davis reports 40 cases with 19 successes 16 partial successes and only 5 failures. In our experience we have a number of patients who possess isografts varying in age from 1 to 9 years. The most striking of these is a child who suffered a congenital absence of the lower lid. The lining of her plastic lid was made from a hinged infra orbital flap and the covering from a full thickness graft taken from the inner surface of the thigh of a nurse who possessed the same blood type. This graft is exceptionally good after a period of 2 years. Shawan concluded from observation and experiment that skin grafting obeys the principle of blood grouping as in the transfusion of blood. It is not only reasonable but highly probable that isografts taken from donors with compatible blood types frequently grow as well as autografts and equally certain that such grafts from donors with incompatible blood may grow but will not persist.

The best sources of skin are the upper arm in the male and the thigh in the female the inner aspect of either being chosen when soft hairless skin is required. There is no especial advantage in choosing skin from an area of tension such as the deltoid nor in taking skin from the prepuce scrotum etc. The only exception is the choice of skin from the ear or another eyelid for grafting about the eye. Nor is there any virtue in producing artificial hyperæmia before cutting the skin or obtaining split skin for Thiersch grafting from a bloodless area. It is within the observation of all of us that epithelial scrapings dust and dried particles of skin will grow but that the ease and certainty of growth will not compare with tissue obtained in the usual manner. This brings us to a consideration of the essentials of growth in grafts. All of the conditions are essential to the full thickness variety while one or two only are vital to the split graft.

It is obvious that a graft is parasitic and must exist upon the absorption of tissue juices or lymph during its first 2 or 3 days of existence. Hence its intercellular spaces must be open to the circulation of lymph in order that nourish



Fig 1 A The graft must be cut accurately to size  
Fig 1 B Contrasted skin removed from area shown in A Note the relative size

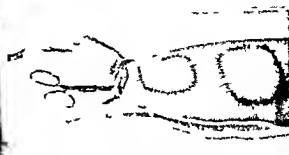


Fig 2 A Grafts applied at pressures of 60 and 100 millimeters  
Fig 2 B Same skin approximated under normal tension

ment may be carried to its cellular elements. Whole blood cannot accomplish this requirement and its collection beneath a graft causes it to perish. These considerations make it obvious that the commonly accepted advice to allow for contraction and to cut the graft one third to one half larger than the area to be covered is one of the commonest sources of failure. The graft must be cut accurately to size and maintained at normal tension (Figs 1 and 5).

For the same reason it must be accurately approximated by carefully placed sutures (Fig 2). The entrance of lymph from its circumference and the early ingrowth of vessels around this border are big factors in successful nourishment. Occasionally one sees a graft which lives for three quarters of an inch around its border and dies in the center as the result of faulty dressing.

The skin must be free from fat. Gillies says that the question of whether a graft shall be skin deep or contain a layer of fat is determined by the needs of the case, there being no marked disparity between the two in the matter of viability. This same claim was maintained by Hirschberg in 1893 and more recently by F. Krause and others. It is true that skin with its fat occasionally grows under very favorable circumstances but consideration of the source of its nourishment and an overwhelming experience to the contrary

by many operators classifies this as an exception rather than a rule.

The graft must be accurately approximated to its base by a proper tension pressure. The necessity for this approximation and pressure has been obvious to all of us but the means of accomplishing the approximation and the question of a proper pressure has given rise to endless opinion and controversy. Numerous dressings have been advocated to meet this requirement, the most recent to win favor being the synthetic rubber sponge. The elasticity and compressibility of this product permits accurate approximation of all parts of the flap but it possesses none of the other virtues ascribed to it.

Various authors describe the proper pressure as gentle, moderate, firm, very firm, and a bandage so tight that it hurts. One may take a choice and guess at the dressing pressure which yields the most success because none of these terms convey the same impression to two individuals.

We have determined by experiment that the ordinary bandage used to fix dressings exerts a pressure upon the soft parts equal to 5 to 10 millimeters of mercury, that a firm bandage exerts a pressure of approximately 30 millimeters of mercury, that a very firm bandage one that is painful when applied to the thigh and



Fig 3 Dressed at pressure of 100 and 60 millimeters of mercury

Fig 4 Dressed at pressure of 110 and 70 millimeters of mercury

cuts off the venous return from the leg exerts a pressure of 45 to 55 millimeters of mercury, and that a dressing applied over a bony base the forehead with all possible tension from a gauze bandage exerts a pressure of 85 to 100 millimeters of mercury.

We have dressed Wolfe grafts prepared and approximated as described with maintained pressures varying from 30 to 110 millimeters of mercury and determined that the higher pressures are disastrous to the flap. Grafts on one patient were applied with pressures equaling 60 and 100 millimeters of mercury (Fig 2). Some areas of the 60 millimeters graft lived after a long questionable period and the greater portion of the 100 millimeters graft softened and came away (Fig 3). Grafts on another patient were applied at pressures of 70 and 110 millimeters of mercury. They promptly became gangrenous and were removed (Fig 4). For this purpose flat moderately thick walled balloons were constructed to produce accurate approximation and maintain the pressure desired. It was observed that stretching of the gauze bandage holding the dressing in position allowed the pressure to fall during the first 2 days and required frequent correction until the stretching ceased. The use of lint band-



Fig 5 At left skin under normal tension and contracted skin

ages and adhesive reinforcement corrects this condition.

The proper pressure must be that pressure which insures maximum nourishment lymph to the part and the graft and prevents fluid collection with consequent flap separation.

Ludwig and his pupils advocated and maintained the importance of the mechanical factor of filtration of blood plasma through the capillary walls as a source of lymph. Starling determined that the quantity of lymph is usually proportional to the height of the capillary pressure. This being true any factor which will raise the capillary pressure will favor the increased flow of lymph. Further we know that the peripheral venous pressure varies from 5 to 15 millimeters of mercury and that the arteriole pressure ranges from 40 to 50 millimeters of mercury. A pressure then which will compress the venules, that is more than 15 millimeters of mercury and will partially compress the arterioles meets our requirement. A dressing at a pressure of 30 millimeters of mercury has been very satisfactory in our experience.

This same care is not vital to the success of split skin grafts. Any inert material will serve to approximate this graft. A simple technique consists in smearing the source of the graft with a thin layer of vaseline which materially facilitates the cutting of the piece and arranging the pieces raw surface outward on dental impression compound which has been molded to the part to be covered. This is applied with a firm bandage without measuring the pressure. The author does not believe that the various types of wet dressings powders etc are essential to the success of grafts.

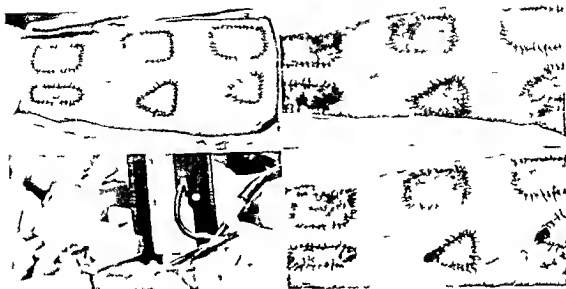


Fig 6 Autograft and control compatible isograft same blood type non-compatible isograft all dressed at

pressure of 30 millimeters mercury Above right second day below right fifth day

Finally the grafted part should be immobilized for several days. During the first 24 hours the graft is glued to its base by coagulated lymph which must not be disturbed.

The following general observations apply to autografts and compatible isografts during their early days of existence.

The presence of a parasitic foreign body the graft induces the reaction of inflammation with a resulting invasion of the corium by large numbers of polymuclear leucocytes.

The epithelium plays no part in the reconstruction and growth until new blood and lymph supplies are established. It frequently degenerates because of faulty nutrition during the period of parasitic lymph absorption before the establishment of a new blood supply.

The papillary area of the corium exhibits marked degenerative changes during the first few days. Some areas perish and substitution occurs from both the tissue of the host and the connective tissue of the graft.

Between the second and the fifth days there is a considerable proliferation of connective tissue cells and vascular endothelium which continues until the time of complete regeneration.

The elastic fibers degenerate late and are regenerated from surrounding elastic tissue.

The following histological observations are furnished by Dr W M German.

*Histology of contracted skin and skin on normal tension.* A Contracted skin Epidermis and

corium are normal in cellular structure. There is a contraction of the corium in all planes throwing the epidermis into numerous folds and causing much irregularity of the bundles of the intercellular substance. The blood vessels are contracted and empty and the spaces between the cells and connective tissue bundles are small.

B Skin on normal tension Epidermis and corium are normal in cellular structure. The connective tissue bundles of corium show a distinct tendency to be parallel to the plane of the skin surface. The vessels are contracted and not all of them are empty. The epidermis is not drawn into convolutions but shows a tendency to occupy a single plane. The spaces between cells and



Fig 7 Tenth day



Fig 3 Dressed at pressure of 100 and 60 millimeters of mercury

Fig 4 Dressed at pressure of 110 and 70 millimeters of mercury

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Fig 10 Autograft compatible isograft and non-compatible isograft twentieth day

layers are in good condition. There is edema of the papillary layer of the corium but the deeper layers are in fairly good condition. At the base of the graft there is an exudate containing polynuclear cells proliferating fibroblasts and endothelial cells with endothelial sprouts showing in vasion of the graft. The elastic fibers are in good condition.

*Isograft from a donor with compatible blood*  
The epidermis has desquamated in places particularly in the superficial layers though basal layers seem to be in good condition. There is edema of the superficial layers of corium with beginning disappearance of connective tissue cells leaving edematous intercellular substance. Beneath the graft there is a beginning attempt in organization with production of endothelial buds.

*Isograft from a donor with incompatible blood*  
There is marked maceration and desquamation of epidermis an accumulation of fluid in the deeper layers and a loss of staining power of the basal cell layer. There is marked degeneration of corium with edema of all structures invasion with polynuclear cells and marked lytic changes in sweat glands. At the bottom of the graft there is an exudation rich in polynuclear cells but showing only scant evidence of organization changes.

#### SPECIMENS REMOVED ON THE TENTH DAY (FIGURES 7 AND 8)

*Autograft* The epidermis is in good condition. It shows some early growth activity in the basal

layers. There is some edema of the papillary process of the corium though for the most part the corium is in good condition. Beneath the corium there is an intense proliferation of young fibroblasts and endothelial cells with endothelial buds which are growing upwards between the connective tissue bundles. The elastic fibers show little change.

*Isograft from a donor with compatible blood*  
In some areas the epidermis has completely desquamated. In remaining portions the basal cell layers are in good condition and show early growth activity. There is marked degeneration of superficial layers of corium the cells are practically absent leaving only edematous intercellular substance. The sweat glands show marked autolytic changes. Beneath the corium there is an exudation rich in polynuclear cells which is infiltrating the spaces between the connective tissue bundles and in some areas a distinct proliferation of young fibroblasts and endothelial buds though less marked than in autograft of the same age.

*Isograft from a donor with non compatible blood*  
Sections show complete loss of epidermis marked degenerative changes throughout the corium leaving only intercellular substance. There is an intense exudation containing polynuclear cells with marked infiltration of the corium by polynuclear cells. There are a few feeble attempts at organization changes limited to the portions nearest the bed of graft. Some areas show necrosis and abscess formation.





Fig 8 Tenth day a autograft b compatible isograft c non compatible isograft

bundles of intercellular substance are distinctly larger than in the case of the contracted specimen (Fig 5)

#### SPECIMENS REMOVED THE SECOND DAY FIGURE 6

*Autograft* There is a beginning maceration of the stratum corneum diminished staining reaction in the stratum granulosum and an increase in pigmentation in the basal layer. The papillary layer of corium shows edema. The deeper layers are in good condition. The elastic fibers show no change. Beneath the graft there

is an exudation rich in polynuclear cells and wandering cells showing a tendency to infiltrate the graft between the connective tissue bundles. The blood vessels are contracted and empty.

*Isograft from a donor with compatible blood* The epidermis is well preserved though there is a tendency to maceration of the stratum corneum. The basal layers of epidermis show diminished staining reaction. There is a moderate edema of the superficial layers of corium with autolytic changes in the sweat gland. Beneath the graft there is an exudation rich in polynuclear cells attempting to infiltrate between the connective tissue bundles of the corium.

*Isograft from a donor with incompatible blood* There is an accumulation of fluid between the stratum lucidum and stratum granulosum and with maceration of superficial layers. The basal layer shows diminished staining reaction. The corium shows distinct tendency to autolytic changes. Connective tissue shows a pyknosis and autolysis of cells with edema of connective tissue bundles particularly in upper layers. The sweat glands and the blood vessels show distinct degenerative changes. At the base of the graft there is an exudation rich in polynuclear cells with scanty fibrin and a distinct tendency to polynuclear infiltration of graft. The elastic tissue bundles show no important changes.

#### SPECIMENS REMOVED ON THE FIFTH DAY FIGURE 6

*Autograft* There is maceration of epidermis extending down to stratum lucidum. The basal



Fig 9 Autograft twentieth day showing organization in the lower layers and at point of attachment

AN IMPROVED SYRINGE AND NEEDLE FOR USE IN REGIONAL ANÆSTHESIA<sup>1</sup>By JOHN S. LUNDY, M.D., ROCHESTER, MINNESOTA  
Sect. A & th. in M. y. Clinic

THE syringe and needle herein described are modifications of those used by Labat and Meeker. The needle however has undergone but one alteration.

The syringe is made with a glass barrel with a capacity of 10 cubic centimeters and metal ends. The attachment for the needle is offset and equipped with a bayonet style lock. The piston is ground to fit the barrel and has been made with a piston ring. Heretofore there has been difficulty with this piston in that the solution would seep past it and accumulate on the wrong side of it. This difficulty has been minimized by increasing the length of the plunger. The barrel has not been lengthened purposely. When the syringe is filled with solution so that the lower border of the piston rests on the 10 cubic centimeter line, only a small space remains for the purpose of aspirating. This is desirable as experience has taught me that gentle aspiration is preferable to a more vigorous one which frequently plugs the end of the needle by attracting tissue instead of blood. On more than one occasion I have aspirated blood from the caudal canal on the third of three consecutive aspirations, although the first two produced no blood. This resulted directly from three degrees of aspiration, the first being *very forceful*, the second less so, while the third was gentle. I infer from such instances that an overvigorous tug on the plunger draws solid tissue against the bevelled tip of the needle and prevents an upward flow of blood. This is undoubtedly true when the bevelled edge of the needle lies against the thin wall of a vein. Successful aspiration of blood has a definite significance. The absence of blood on

the other hand may prompt a feeling of false security based on the belief that the needle is outside a blood vessel. As an additional precaution against misinterpretation, therefore, I very carefully and slowly inject three or four drops of the solution with the idea of freeing the tip of the needle from the tissue before gently repeating the aspiration. This is first done without moving the needle, then it is repeated while the needle is rotated. If no blood is obtained under these circumstances, one can be reasonably sure that the injection will not be into a vein. Nevertheless the solution going into the caudal canal should be injected very slowly while the patient is closely watched for signs of the sudden reaction characteristic of an intravenous injection.

The handle or grip on this syringe consists of a finger ring on the end of the plunger. Small flat metal rests occupy the top and bottom of the ring and provide satisfactory pressure bearing surfaces whether the thumb is in the ring or the ring pressed against the palm. Two finger rings split laterally have been placed on either side of the metal cap which screws onto the end of the barrel. The split ring permits the gloved finger to be withdrawn both laterally and longitudinally, so that the hand is easily disengaged. The use of rubber gloves while the injection is being made prompted the introduction of this new grip. The side rings together with the thumb ring permit

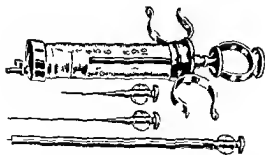


Fig. 1 Drawing of syringe and needles.

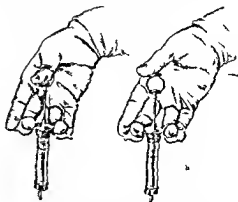


Fig. 2 a Injecting with thumb through ring of plunger and fingers in rings b Injecting with thumb above ring of plunger and fingers in rings

SPECIMENS REMOVED ON THE TWENTIETH DAY  
(FIGURES 9 AND 10)

*Autograft* Section of upper layers of skin showing the epidermis is in excellent condition with growth activity. The corium likewise is returning to normal.

Section through deeper layers showing the wide zone at the base of the graft of well organized repair tissue.

*Isograft from a donor with compatible blood* Section through upper layers. Absence of epidermis and only a few remaining strands of former corium which is degenerating and surrounded by granulation tissue containing phagocytic cells.

*Isograft from a donor with non compatible blood* Section showing almost complete removal of former corium, one small island remaining in the center of field. Masses of granulation tissue in filtrate with phagocytic cells.

These essentials to the growth of full thickness grafts have been advocated by the author for a dozen years. The principal of cutting to exact size and carefully approximating to maintain

normal tension was advanced by him and practiced by several operators with considerable success in The Queens Hospital in England during the War and has since been urged on numerous occasions. It is to be hoped that the substitution of sound scientific proof for former theory will stimulate a wider application of this very useful procedure.

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abdominal cavity and even though damage is seldom done it is to be avoided if possible. The tapered shoulder lends strength to the needle and for that reason it is used on needles of different sizes from those ordinarily employed in abdominal block.

The syringe and needles are easily sterilized by boiling. The syringe may be kept in alcohol between cases when frequently used. Needles are

freshly sterilized in boiling water. Information as to the care of syringe and needle may be found elsewhere.<sup>1, 2</sup>

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## PRURITUS AND TREATMENT BY ALCOHOL INJECTION

By HARVEY B. STONE, M.D., F.A.C.S., BALTIMORE, MARYLAND  
Fifth Surg. 15th Ave. J. H. Park Bldg. by Dr. J. M. D.

THE purpose of this paper is to call renewed attention to a method of treatment for pruritus already published and to report further experience in its use.<sup>1</sup> There is no need for an elaborate general discussion of pruritus. Some cases of itching about the anus are no doubt due to various local causes such as small fistulae, irritated skin tags, and pin worms, and a few may be reflex manifestations of some visceral lesion as Montague has urged or due to some general condition like diabetes. A fairly wide experience, however, leads to the firm opinion that true pruritus ani of the idiopathic type is a genuine clinical entity of characteristic appearance, the cause of which is entirely obscure at present. The intensity of the itching varies from a minor annoyance to a serious disturbance of health with loss of sleep and distressing nervous irritability.

There is no satisfactory treatment. The method herewith presented is not satisfactory for one reason: it is not as a rule permanent in its results. In this regard it is not different from other procedures. Otherwise it is by far the best treatment with which the writer is familiar and has afforded most welcome relief to many patients. The details of execution of the injections will be described, and then a brief statement of its rationale and of our results will be presented.

The patient is placed in the lithotomy position under light general anesthesia; ethylene gas is particularly suitable, but nitrous oxide or light ether may be employed. Formerly local anesthesia was given in a number of cases, but general narcosis is better. The infiltration of the tissues

with local anesthesia dilutes the alcohol and is otherwise confusing by distending the area injected. The field is prepared as for any operation and by the field is meant the whole of the area involved. At times this may extend backward over the sacrum forward about the genitalia and groins and laterally toward the buttocks. The patient can describe the extent of the involvement before operation, but as a rule the inflamed and indurated appearance of the skin itself indicates the region to be injected. The material used is pure 95 per cent grain alcohol without denaturing substances. This is injected with the ordinary small hypodermic syringes with fine needles not over an inch long. Larger syringes and coarser needles may lead to placing too much alcohol in one spot or putting it in under too great pressure. The needles are plunged vertically entirely through the skin and the alcohol injected into the subcutaneous tissues. Only to 4 drops are injected at each puncture. The punctures are spaced about  $\frac{1}{4}$  inch apart and are stopped over the entire area involved. The injections are carried up to about  $\frac{1}{4}$  inch from the anal margin but are not made within the anal canal itself. The scrotum, labia majora and folds of the groins have been injected without resulting trouble. Blood vessels of course are to be avoided when possible.

After completing the injection the area is sponged off with a wet alcohol sponge. No dressing is used. There is little after soreness, and if the injection has been properly performed the itching is abolished at once. When the method was first being developed there was some concern about possible sphincter paralysis and sloughing of the skin. In no case has there been

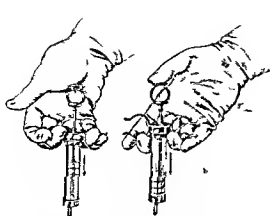


Fig. 3 a Injecting with ball of thumb and ring of plunger and fingers through rings b Injecting with thumb on plate over ring of plunger and fingers beneath rings

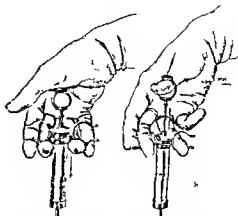


Fig. 4 a Ball of thumb over ring of plunger for injecting and other fingers beneath rings b Filling syringe by pulling upward on plunger with thumb in ring of plunger and other fingers in rings

five different grips the most comfortable one depending on the size of one's hand the amount of solution in the syringe and the amount of pressure desired (Figs 1 2 3 and 4). The effect is to produce the desired pressure at all times and although high pressure may result disastrously to the syringe nevertheless there are times when it must be produced. A field block in the scalp for instance often requires that the solution be injected with more than the average pressure. This grip or handle has slightly increased the bulk and weight of the syringe but when the barrel is full of solution the instrument has a very satisfactory balance. For those who inject many patients in succession this grip affords a certain amount of rest for the hand inasmuch as the four fingers are divided and two may be placed in each split ring instead of one. The preferable grip on a syringe is with the thumb middle and ring fingers whether two fingers are in a ring or not. Aspiration and refilling are accomplished with one hand (Fig 4b) if the piston has been carefully ground to fit the barrel otherwise it would stick and require the use of both hands to fill the syringe.

The needle has been especially prepared for the injection of the abdominal wall. The shoulder of the needle has been tapered to join with the shaft giving it the appearance of an awl (Fig 1). It is possible to dilate the skin perforation so that injection may be made without any drag on the shaft of the needle. By eliminating the friction of the skin against the shaft of the needle the jerk of the needle as it punctures the fascia has been

exaggerated. For the novice this is a safeguard in the ordinary abdominal injection for the experienced operator it is a safeguard when fascial layers are so thin that with the ordinary needle there is no jerk when they are punctured.

The needle after being firmly attached to the syringe is passed through a wheal already raised. It is then thrust parallel to and immediately below the surface of the skin until the entire shaft is buried. The tapered shoulder is then forced in after the shaft until the hole in the skin has been dilated sufficiently to permit an entirely free motion of the shaft through it. If the shaft should break it would still be subcutaneous and parallel to the surface and therefore easily removed by forcing it on through the skin and upward to the outside by pressing downward and forward against the broken end of the shaft at the same time with the forefinger of the other hand pressing the skin down and against the sharp point of the needle. After part of the solution has been injected subcutaneously the needle is withdrawn until the point lies just under the original wheal. It is then advanced downward and the fascia is searched for. When found this is perforated and about 2 cubic centimeters of solution injected there. The various necessary fascial punctures are thus accomplished with a feeling of satisfaction that the peritoneal cavity has not been pierced. Patients with such thin or delicate fascia that they cannot easily be felt constitute a considerable number of the cases to be injected and are obviously of considerable concern. It is common knowledge that the needle occasionally enters the

## THE TREATMENT OF THE ACUTE POSTOPERATIVE TOXÆMIA OF HYPERTHYROIDISM

By JOHN ROGERS MD FACS NEW YORK CITY

THERE are few more dangerous conditions than the acute postoperative toxæmia of hyperthyroidism. In my experience it has occurred most commonly in those patients who present symptoms of marked exophthalmos especially if they have previously had a pallid skin, or one which has become pigmented or bronzed or a perceptible muscular atrophy in the hands and forearms. It is also more to be expected in those with firm rather than soft thyroid glands. In postmortem examinations of the gland only a dense mass of cells has been found with little or none of the colloid material which is supposed to represent the secretion. In other words the patient dies apparently not from too much but from too little thyroid secretion or an entire absence of it.<sup>1</sup> For this reason I have for several years advocated in the treatment of the acute postoperative toxæmias the subcutaneous administration of a boiled aqueous extract of the thyroid. It seems to act by stimulation of the terminal filaments of the vagus or parasympathetic portion of the involuntary nervous system and so does not increase the already alarming rapidity of the heart action.<sup>2</sup> This extract is now commonly available in a form known as the thyroid residue. The detailed histories are given of 3 cases recent experiences in rather close succession of these serious postoperative toxæmias in which the patients seemed to be saved from death by the free administration of the thyroid residue.

CASE 1. Miss M G. age 18 was first seen in December 1924. She apparently showed the beginning of rather typical symptoms of mild exophthalmic goiter. She had worked very hard the preceding winter at school. The general nutrition was good when she was quiet in bed the skin was pallid but flushed at the least excitement there was distinct exophthalmos and a small rather soft goiter. The pulse rate averaged 112 the systolic blood pressure was 140 and the weight 123 pounds.

On January 19, 1925 under local anesthesia both inferior and then a week later both superior vessels were tied. There was comparatively little reaction and much improvement which seemed to be promoted by the administration of a 1 grain iodide of iron pill daily with a glycerin ovarian extract.

In February with a normal pulse rate and a gain of 5 pounds in weight she went home where she was forced to take up a somewhat strenuous life. The hyperthyroid symptoms then began to reappear again in the latter part of

April 1925 she returned to the hospital. The general nutrition was good but there was a marked and somewhat dusky pallor with distinct muscular atrophy in the hands and forearms. The exophthalmos was more pronounced than in December the pulse rate averaged about 130 the systolic blood pressure was 150 and the weight was 120 pounds the goiter was no larger but had become dense in consistency. With rest in bed and a continuation of the iodine and ovarian feeding for about 3 weeks the pulse rate decreased to an average of 115 but the gland remained very dense.

May 19, 1925 under gas-ether anesthesia the isthmus of the thyroid was excised and both lobes resected so that they were reduced to an approximately normal size. The cut surfaces of the organ resembled liver tissue. At the end of the operation the pulse rate was 160. Four hours later it had risen to 180 but there was none of the extreme restlessness which in my experience indicates an impending fatality.

The following morning the pulse had risen to 190 and the temperature to 103 and there was nausea and more restlessness. The condition appeared very serious. 15 minutes of the thyroid residue were then given every two hours by mouth rather than hypodermically as the patient vigorously resented the use of the needle. An almost immediate improvement followed. The nausea and restlessness decreased and within the next 48 hours the pulse rate dropped from 190 to 150 and the temperature from 103 to 101. As the danger seemed passed the thyroid feeding was then stopped and on the fourth day after operation the pulse rate had fallen to 120 and the temperature was normal.

The patient left the hospital at the end of the third week after operation with a pulse rate which averaged between 90 and 100.

In this patient there was so much fear of the hypodermic syringe that it seemed unwise to force it but the mouth administration of the thyroid extract seemed beneficial, and was certainly not followed by any increase of nervous irritability nor acceleration of the pulse rate. Of course recovery might have taken place without it. Nevertheless recovery with a rapidly rising pulse rate and temperature before the administration of this remedy seemed doubtful.

CASE 2. Miss M R. age 24 was first seen in September 1924. She had always been delicate and her present symptoms of typical exophthalmic goiter apparently followed an attack of pyelitis a year or more ago. In September 1924 she had been in bed for 3 months under small doses of iodine. The metabolism was +50 there was a moderate exophthalmos a rather dense and small goiter the pulse rate averaged 115 systolic blood pressure 130 weight 84 pounds.

In November 1924 under local anesthesia both inferior thyroid arteries were ligated and a week later both superior. A 1 grain iodide of iron pill was then given once daily and glycerin ovarian extract every 4 hours. Marked

any muscle disturbance and with the technique here described no sloughs of any moment what ever have developed. Among the first cases there were several sloughs due to the placing of too large a volume of alcohol through single puncture wounds and also to injecting by mistake into the skin instead of under it. After an injection there is a noticeable numbness of the perianal skin but no disturbance of the sensory features of the act of defecation. There is a remarkable return of the skin to normal appearance within a few days after injection.

The principle upon which this treatment is based is the well known destructive effect of alcohol on nervous structures. It is analogous to the alcohol injections for trigeminal neuralgia. In the latter case there are a few definite nerve trunks to be reached. In the case of pruritus the objective is the network of fine terminal sensory filaments that supply a varying area of skin. Hence the difference in technique. An alcohol injection does essentially the same thing as the surgical division of these cutaneous nerves as aimed at in the Ball and Lynch under-cutting operations and does it in a better and less objectionable way.

In the first publication on this subject reference was made to the experimental development of the method on animals by which the technique was worked out.

This treatment has been in use now for over ten years in the Rectal Clinic of the Johns Hopkins Hospital. During this time something over two hundred injections have been performed by Drs. A. H. Hebb, William Noble and myself. Numerous other surgeons of my acquaintance

have employed it occasionally. As a result of this experience the following conclusions may be drawn:

#### CONCLUSIONS

An injection properly performed by the technique herewith described gives prompt and complete relief. There are no serious complications or disadvantages to fear. With care sloughing may either be avoided entirely or reduced to a negligible degree. There is no prolonged hospital stay, no repeated treatments nor disagreeable applications to be made. The freedom from itching lasts for a variable and unpredictable time. A few cases are apparently cured yet in such a case a recurrence developed after 6 years of complete freedom and was then re-injected. A number of patients have had relief for several years. Some develop itching again within 3 months. The greater number seem to be clear for from 6 to 12 months and then again are annoyed by the itching. Rarely is this as intense as at the time of the first treatment. There is no objection to repeating the injections as often as may be necessary. One patient a physician had his first treatment about 9 years ago and has had two others in the intervening time several years apart. It is freely admitted that this tendency to recurrence constitutes the great defect in the method. On the other hand it is eloquent evidence on its behalf that a number of patients who have tried almost every other form of treatment having received one alcohol injection return when necessary for a second or a third injection in spite of recurrence and with a wide experience of the possible alternatives.

ECLAMPSIA ETIOLOGY AND TREATMENT<sup>1</sup>

By HOWARD F. KANE, A.B., M.D., F.A.C.S., WASHINGTON, D. C.  
 From the Obstetrical Service, Free Hospital, N. Y. City

**E**CLAMPSIA is an acute toxæmia occurring in pregnant parturient or puerperal women and is accompanied by clonic and tonic convulsions during which there is loss of consciousness followed by more or less complete coma and frequently results in death. In this definition by Williams is told all that is actually known of the etiology of eclampsia.

Many theories have been evolved the results of centuries of speculation by numberless workers in obstetrics few have withstood the test of time and experience. With each new theory as to the cause of eclampsia there has been proposed a new plan of treatment. Many of these methods have been discarded permanently, others have been abandoned temporarily while one or two principles have up to the present time been universally recognized as correct.

Every theory which has been proposed as to the cause of convulsive puerperal toxæmia has some degree of plausibility and until our knowledge shall be greater than it now is no idea should be dismissed without careful consideration and absolute proof of its unworthiness. At the present time it seems true that the toxin of eclampsia originates in the product of conception, that it is eliminated principally by the bowels and kidneys and that it results in profound toxæmia when the digestive tract is not functioning properly. When to the fetal toxins are added the results of sluggish bowel action and a high protein diet the maternal organism is overtaxed. The most successful methods of treatment are those which combat the formation and retention of toxins in the alimentary tract.

It is generally recognized that there are two types of convulsive puerperal toxæmia, one which seems to be due to primary kidney pathology and one the true eclampsia in which the first changes are found in the liver with nephritis as a secondary complication. The treatment is the same in both cases.

The etiological theories which have had the strongest support are (1) infection, (2) glandular dysfunction, (3) incompatibility between fetal and maternal blood, (4) fetal toxins and (5) diet and faulty elimination.

Stroganoff has shown the similarity between eclampsia and acute infections, noting the mode of onset, the effect on all parenchymatous organs

the fact that there seems to be an epidemic form and that one attack seems to confer immunity. Talbott found sepsis in the teeth of all of 97 eclamptics and believes that kidney damage resulting from these foci of infection is the primary cause of eclampsia. McIlroy stresses dental prophylaxis in the prevention of toxæmia. Focal infection is also blamed for the formation of placental infarcts which result from thrombosis of the uterine vessels. Frequent hæmatogenous infections of the kidney by colon bacillus have been noted.

Pathology of every endocrine gland has been suggested as a cause of eclampsia. It is believed by some that the physiological hypertrophy of the thyroid during pregnancy serves to promote the increased liver metabolism made necessary by pregnancy. When the thyroid does not enlarge during pregnancy toxæmia should be anticipated. Kosmak reports a case of profound toxæmia in a thyroidectomized patient. Hypertrophy of the parathyroids has been urged as a cause. On account of its similarity to parturient paresis in cattle, a disease which is undoubtedly due to activity of the mammary gland, it has been thought by some that eclampsia is due to derangement of the milk-forming function of the human breast. Willson's comparison of the two conditions is striking. Hofbauer and others assert that the convulsions are due mainly to exaggerated activity of the hypophysis cerebri during pregnancy which causes vascular spasms in the brain.

A number of observers were convinced that the cause of eclampsia could be found in incompatibility between the fetal and maternal blood. Further investigation however tends to show that the blood group has no influence. According to Young, when interference with the maternal blood supply causes infarcts and partial separation of the placenta, autolysis of the placenta liberates toxic substances and toxæmia ensues. Willson and Williamson have pointed out the relationship between premature separation of the placenta and toxæmia. Veit believes that a distinct toxin, syncytiotoxin, is to be found in the maternal blood.

The effects of fetal toxins and anaphylaxis are believed by many to be the cause of eclampsia. Levi Solal and Tzanck have found in the serum of eclamptics two toxic principles, one convulsive, the other lethal. They believe that susceptibility



improvement followed and in March 1925 the pulse rate averaged about 90 and there had been a gain in weight of 10 pounds. She resumed her work in a shop but that apparently caused a relapse and in May she returned with the former symptoms much increased. The previously pallid skin was some what pigmented the exophthalmos was pronounced the previously soft thyroid felt dense the pulse rate averaged 130 the systolic blood pressure was 140 the weight was 87 pounds. There was some diarrhoea little or no subcutaneous fat and distinct muscular atrophy in the hands and forearms. In short she presented a bad operative risk.

After 2 weeks in bed with the former medication of iodine combined with a glycerin extract of adrenal which seemed to check the rather frequent bowel movements there was some improvement in the nervous irritability and the pulse rate averaged about 120.

On May 13 1925 under gas-ether anaesthesia the isthmus of the gland was divided and each lobe resected to approximately the normal size. In spite of the previous ligation of all four of the chief thyroid vessels the hemorrhage was quite troublesome apparently coming from the thyroid veins. The cut surfaces of the gland as in the previous case resembled liver tissue. At the close of the operation the pulse rate was 160 to 170 and during the afternoon ran to between 130 and 190 and the temperature had increased to 103. The restlessness was partly controlled by morphine.

On the following morning the pulse rate was difficult to count but probably did not reach 200 and the restlessness had been succeeded by stupor. The temperature was 103.5 degrees F. Twenty minims of thyroid residue were then given every 4 hours hypodermically. In the afternoon consciousness was so fully restored that she ejected vigorously to the hypodermic needle and the pulse rate had begun to decrease. The next morning the pulse rate and general condition were so obviously improved that the hypodermic medication was stopped. In the evening of the third day after operation the pulse rate had decreased to 110 and a week later was practically normal.

I have seen other patients who developed similar symptoms referable to the central nervous system but not another in stupor who recovered either with or without the hypodermic administration of thyroid. In this particular instance it seemed to be life saving.

CASE 3. Mrs. A. S. age 16 was first seen in May 1915. She gave a history of scarlet fever 2 years previously. Six months after recovery the goiter was noted. This gradually increased in size and then the exophthalmos appeared. There was a pronounced pallor when at rest but the least excitement or exertion produced a flushed and moist skin there was pronounced exophthalmos more noticeable in the right than in the left eye. There was a large firm goiter extending from the suprascapular region well above the thyroid cartilage (higher on the right than the left side). There was a distinct pulse in the easily palpable superior vessel. The pulse rate averaged 130 the systolic blood pressure was 70 the weight was 111 pounds the metabolism was taken at only 35 but the other symptoms seemed to indicate a bad operative risk.

June 2 1925 both inferior thyroid vessels were ligated under local anaesthesia. As a preliminary operation this is simpler and subsequently much less painful than the common ligation of the superior vessels.

On June 9 the pulse rate had decreased to an average of 100 and the temperature which had varied between 100 and 101 was normal.

June 10 1925 under gas-ether anaesthesia after both superior vessels had been ligated the right lobe was resected to nearly the normal size and the superficial part of this lobe with the isthmus removed. While the left lobe was being resected the pulse suddenly began to be very feeble and rapid as could be noted by the brachial vessel and by the apex of the heart. Its rate could not be accurately counted but it was above 200. Thirty minims of the thyroid residue were then administered hypodermically into the left arm and the operation continued. But 3 minutes after the injection the heart beat became violently stronger and after the wound was closed the pulse rate was counted at about 200. Thereafter for 24 hours 20 minims of the thyroid residue were given hypodermically at intervals of 2 hours. The temperature did not go above 103 and comparatively little of the usually threatening nervous irritability developed.

The pulse rate under this treatment steadily declined and on the second day after operation was 120. For the next 3 days the thyroid residue was given every 4 hours and then stopped as it seemed to produce no further benefit.

On June 20 the pulse rate was 100 respiration 20 and the temperature normal.

This patient like the other two seemed thus to be saved from a very dangerous condition. Without the thyroid residue given during the operation I feel sure she would have died. In none of these cases was any ill effect noted.

This does not mean that the extract is harmless because I have tested it in patients who were under the usual medical treatment for severe hyperthyroidism and it evidently intensified the disturbance.

The medical crises of hyperthyroidism do not usually develop with such startling rapidity as do those which follow operation. Furthermore the evidences of total absence of colloid are not so clear. The appearance of the cut surface of the gland during the operation and the necessary accompanying traumatism which should temporarily stop the functioning of this organ supply good reasons for the administration of an active thyroid extract. Because the more prolonged types of the disturbance are often intensified or at least not manifestly benefited by the treatment I have hesitated to employ it and in the postoperative toxemias I think I have hitherto generally waited until it was too late. After the central nervous system has become badly damaged no treatment can prevent death. But when alarming symptoms appear during the operation or immediately afterward I do not hesitate to administer the thyroid residue in 20 or 30 minims doses every 2 hours. I believe that under these conditions it is entirely harmless and can be more beneficial than any other treatment.

Lawrence explains the effectiveness of these procedures on the ground that morphine gastric lavage and colonic irrigation incite antibody production while delivery and venesection check production and distribution of fetal toxins.

After venesection we employ 10 per cent glucose solution intravenously to the amount of 500 cubic centimeters hoping thereby to aid in the regeneration of damaged liver tissue. The suggestion of Thalheimer that insulin be used to increase carbohydrate metabolism has not yet been carried out. Acidosis is also combated by retention enemata of 6 ounces of glucose and soda 5 per cent solution of each every 4 hours.

We do not induce profuse sweating believing that in doing so we concentrate the toxin in the blood and unduly depress the patient. She is kept warm and usually in a gentle perspiration by means of hot water bags. Veratrum viride is not used. This drug will reduce blood pressure, but does nothing toward removing the cause of the disease. Pituitrin is not used in any stage of the treatment.

Unless the second stage of labor is very rapid, we hasten delivery after full dilatation of the cervix by forceps or version. Cesarean section is reserved for the primipara with an undilated cervix in the occasional case which does not improve under conservative treatment. Now and then in spite of the treatment outlined above the blood pressure remains high, coma is not lessened and convulsions continue. Then cesarean section is performed if the condition of the cervix will not permit delivery through the vagina. We are convinced that time utilized in procuring elimination and sedation is time well spent and that this preparation increases the likelihood of recovery after the operation.

The series of cases to be reported is too small to be taken as proof of the efficiency of the conservative method of treating eclampsia. It is presented as an addition to the mass of evidence which has accumulated and is simply a record of the work of the past year at Freedmen's Hospital.

Eighteen cases of severe toxæmia were admitted. Three were not having convulsions and were classed as pre eclamptic toxæmia. Two died almost immediately after reaching the hospital before any treatment could be instituted. Remaining are 13 cases of eclampsia which were treated.

In 3 cases cesarean section was performed as soon as possible after admission. All 3 patients died—one 1½ hours, one 2 days and one 3 days after operation—a mortality of 100 per cent.

Of the 10 patients treated conservatively all lived a mortality of 0 per cent. Two of the 10 were admitted in coma with convulsions, recovered, were discharged and returned later to be delivered of living babies. One patient a primipara was delivered by cesarean section after thorough elimination and sedation.

Fortune is undoubtedly responsible in part for this striking contrast in the results of two methods of treatment. All cesareanized eclamptics do not die and many eclamptics will die in spite of all treatment. Our results, however, have caused us to be firmly entrenched on the side of conservatism.

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to toxin is due to variation of sympathetic tone and experimented with drugs acting on the sympathetic nervous system. Pilocarpine used on guinea pigs was successful in combating the action of the lethal dose of eclamptic serum. One patient who had had nine convulsions was given 5 milligrams of pilocarpine 3 times in 24 hours. She had no convulsions after the first dose and recovered. The work of these authors helps to disprove the agglutination theory as they found that after inoculating animals with eclamptic serum injection of sodium citrate prevented coagulation but not death.

The influence of diet and faulty elimination has practically been proved by the clinical results of treatment directed toward the correction of errors in these particulars. Warnke, who bowed that in Germany during the war eclampsia was much less frequent. At that time there was little fat and protein to be had and pregnant women were forced to live on a low protein diet.

In treating eclampsia one should bear in mind all the possible causes and direct his efforts toward combating them. The chief difficulty lies in placing proper value on the various etiological factors. At present obstetricians are divided into two schools: one believing that removal of the products of conception is all important and the other preferring to treat the toxæmia primarily, leaving the evacuation of the uterus to nature or to nature slightly assisted.

The evil consequences of accouchement force and other brutal methods of rapid delivery caused the obstetricians of former days to devote their efforts toward more conservative means of treating eclampsia. Then with the advent of asepsis and the increased safety of cesarean section delivery by the abdominal route came into favor. This is without doubt the easiest way in which to terminate pregnancy and if simple evacuation of the uterus would cure eclampsia there would be no need for further investigation of the subject. It has been shown, however, by statistics gathered from the whole world that the mortality following cesarean section in eclampsia is over 30 per cent.

Originated by Stroganoff and popularized by Rotunda Hospital a conservative method of treating eclampsia and pre-eclamptic toxæmia has with many modifications been widely adopted. Though carried out in various ways the principles of treatment are constant. The objectives sought are sedation, elimination and in some cases hastening evacuation of the uterus. Eden concludes after a study of the methods of treatment in England that natural delivery assisted deliv-

ery, or induced labor give twice as good results as cesarean section. In general the mortality after conservative treatment is 10 per cent.

Stroganoff uses chloroform and chloral hydrate as sedatives. In this country we are taught that these drugs cause liver necrosis and therefore are contra-indicated in eclampsia. At Rotunda morphine is used though not in the massive doses formerly recommended.

In the obstetrical service at Freedmen's Hospital, we have attempted to employ in the treatment of eclampsia every method which seems to have value.

We believe that the convulsion in itself is a source of grave danger. As Stroganoff says the convulsion causes temporary asphyxia and cardiac dilatation, an increase in nervous irritability and depression of the kidney secretion. The general muscular contraction increases the amount of toxin thrown into the system, weakens the organism and hastens the fatal outcome. We attempt to control convulsions by the use of morphine. One half grain is given hypodermically at the first convulsion or when the patient is first seen. One quarter grain is given with each succeeding convulsion until the respirations fall to ten per minute. We feel that whatever locking up of secretions may be caused is more than offset by the sedative effect. We believe also that the effect on the fetus is negligible. No anæsthetic is used to control convulsions. A general anæsthetic prevents the inhalation of air. What the patient needs is oxygen and after each convulsion a few breaths of oxygen are administered to combat cyanosis.

Elimination is effected by stomach lavage until clear return and colonic irrigations of 5 gallons of fluid. For each of these procedures we use 5 per cent sodium bicarbonate solution. After the lavage 2 ounces of magnesium sulphate are introduced through the tube. Neither of these treatments is given until after the patient is well narcotized by the morphine as such manipulations tend to induce convulsions. Formerly the colonic irrigation was repeated several times at 4 hour intervals. We have found, however, that one flushing seems to clear the bowel and we try to avoid further disturbance of the patient.

If the blood pressure is above 170 millimeters venesection is performed. We consider this procedure to be of the greatest importance. By it we lower the blood pressure, relieve the heart, lessen oedema of the brain and probably remove actual toxin. We withdraw 600 to 1000 cubic centimeters or less if the blood pressure falls to 150 millimeters.

POSITIVE RESULTS OBTAINED WITH CORPUS LUTEUM  
EXTRACT BY THE VAGINAL SMEAR METHOD IN  
CASTRATED RATS

| M t al | N      | T al | amo t  | Source        | P pa tio             |
|--------|--------|------|--------|---------------|----------------------|
| Rats   | in m l | gr m |        |               |                      |
| 61     | 5-6-7  | 55   | 11 g   | Prol          | re p e c t a t i o n |
| 68     | 8-9    | 35   | 11 g   | Alcohol       | 1 h                  |
| 69     | 10-11  | 35   | 11 g   | Alcohol       | 1 h                  |
| 95     | 12-13  | 35   | 11 g   | P u l p       | p t a t              |
|        |        | 175  | 11 g   | Sapo          | scat                 |
| 7      | 8-14   | 90   | 11 g   | Alcohol       | 1 h                  |
| 99     | 6      | 55   | 11 g   | Alcohol       | 1 h                  |
| 100    | 13     | 75   | 11 g   | Protein       | re p e c t a t i o n |
| 101    | 13     | 75   | 11 g   | Pregnancy     | small                |
| 0      | 26     | 75   | 11 g   | Pregnancy     | large                |
| 3      | 13     | 100  | 11 g   | Pregnancy     | small                |
| 3      | 13     | 100  | 11 g   | Sapo          | scat                 |
| 100    | 75     | 11 g | Min    | phosphatides  |                      |
| 75     | 75     | 11 g | Sapo   | baloon        |                      |
| 77     | 3      | 75   | Cow    | lecith        | cephal d som         |
| 175    | 1      | 75   | Cow    | lecith        | cephal d som         |
| 81     | 4      | 44   | 75     | Min           | cholesterol          |
| 95     | 5      | 25   | 11 g   | Min           | lecith               |
| 100    | 80     | 8    | 11 g   | Alcohol       | 1 h                  |
| 100    | 73     | 80   | 11 g   | Alcohol       | 1 h                  |
| 00     | 26     | 80   | 11 g   | Alcohol       | 1 h                  |
| 3      | 45     | 11 g | Yellow | and p t m n   | h t terol            |
| 47     | 75     | 11 g | Bloody | minus ch test | h                    |
| 121    | 49     | 75   | 11 g   | P k m n       | b l l e r            |
| 175    | 75     | 11 g | Yellow | and p t m n   | h t terol            |
| 175    | 75     | 11 g | Yellow | and p t m n   | h t terol            |

On m t e r a t d m a i n l y o f b y o v a r i e s F a r s t t h i s t  
i n d u c e s o u r t e d N t h a t o r g a n s t h e r e c a l l e d t w h t  
i n p r o o v e d t h e s e u g h t y w h r u n g w t e r t h w h d  
w i t h r m i s a l t s o l u t i o n d d i l y b i l i t y d r e m e n t d u  
d t o l u m t e l l m t a w i t h f o l l i c l e d T h m t i  
w t h g t d t t w i t h v a s o l u p o d t v t a T a l  
A m t g t s e a m t p t o e h a m t

It is of interest to note the amount of the cholesterol found in the lipid fraction of the following tissues

|                      | P t   |
|----------------------|-------|
| Bloody corpus luteum | 53.5  |
| Yellow corpus luteum | 32.9  |
| Follicle fluid       | 17.86 |
| Placenta human       | 16.93 |

After concentration obtained by eliminating the cholesterol lecithin and cephalin from these fractions the minimum total amount necessary to produce a positive reaction in the castrated rat was

|                      |                |
|----------------------|----------------|
| Follicle fluid lipid | 15 mgm average |
| Placenta lipid       | 37 mgm average |
| Corpus luteum lipid  | 75 mgm average |

which while it gives a rough comparison of the potency of artificial extracts supplies no estimate of the amount of hormone set free in the blood stream.

Why did Johnston and Gould fail to obtain positive results with corpus luteum extracts? The reason is twofold (1) They evidently failed to concentrate the extract sufficiently—just as we failed in our earlier work and (2) gave subthreshold doses. In eliminating protein and cholesterol (the latter representing over 50 per cent of the lipid mass) the hormone readily may be lost. Moreover the dosage as our results show must be five times

that of follicle lipid and twice that of placental material.

It might further be argued that the hormone obtained by us from corpus luteum is different from that derived from the follicle fluid but the chemical researches of my collaborator Gustavson have shown that the female sex hormone whether obtained from follicle fluid corpus luteum or placenta can be freed from all nitrogen phosphorus cholesterol and cholesterol reactions that from whatever source derived it shows the same chemical properties and the same composition (C H perhaps O).

And finally tested by the reaction produced on the contraction rate of the isolated uterus of the rat follicle corpus luteum and placental extracts were found identical in action (Frank Boneham and Gustavson *Am J Physiol* 1925 lxxiv 395).

It is therefore apparent that to call the female sex hormone the ovarian hormone or ovarian follicular hormone as Johnston Allen and Doisy etc have proposed is inadequate because the female sex hormone is secreted not only by follicle but also by corpus luteum and placenta.

In order to emphasize this multiple derivation as well as to mark its physiological purpose we (Frank and Gustavson loc cit) have proposed the name of *gestational gland* for the three structures which secrete the female sex hormone. The purpose of the female generative tract is for procreation. The female sex hormone through the secretion of the follicle initiates the pregravid pelvic and mammary reaction up to the time of ovulation. After ovulation has taken place the corpus luteum further accentuates the reaction and continues it until the yellow body becomes functionless if the sex cycle proves abortive (infertile). If impregnation supervenes the placenta protracts the cycle throughout pregnancy and brings the necessary tubular (vaginal and uterine) as well as mammary hyperplasia to its acme and conclusion ending with birth of the young. Unless these fundamental facts are recognized the physiology of sex and reproduction remains unexplainable and obscure.

ROBERT T FRANK M D F A C S

New York City

To the Editor In a criticism of our article The Corpus Luteum as a Source of the Follicular Hormone which appeared in your journal (February 1926) Dr R. T. Frank states that there are but two deductions that can be drawn from our paper namely (1) that we have failed to read some of the recent literature and (2) that we have failed to obtain potent corpus luteum extracts.

Dr Frank's first deduction is based on the fact that we did not refer to an article by him and R. G. Gustavson (*J Am M Ass* 1925 lxxiv 1715). It is apparent that this deduction is based on entirely fallacious reasoning. After we mailed our manuscript to you we read and discussed their article and were fully cognizant of its contents. We

# CORRESPONDENCE

## THE CORPUS LUTEUM AS THE SOURCE OF THE FOLLICULAR HORMONE

To the Editor From the article of Charles G Johnston and Victor L. Gould entitled *The Corpus Luteum as the Source of the Follicular Hormone* which appeared in your journal in February (1926 xlii 236) it is impossible to determine when the experimental work was completed and on what date the manuscript was given into your keeping. Whether or not completed before June 6, 1925 it certainly must have been feasible at least during the final revision of the proof to have considered the article of Robert T. Frank and R. G. Gustavson entitled *The Female Sex Hormone and the Gestational Clend* (J Am M Ass 1925 lxxv 1715 June 6) which more than covered the ground of Johnston and Gould's research and which explains why these authors obtained negative results with corpus luteum. The questions involved are of such fundamental importance to the profession that I feel justified in correcting the impression conveyed by Johnston and Gould.

The only deductions that can be drawn from their paper are (1) that the authors have overlooked some of the recent literature and (2) that they have failed to obtain potent corpus luteum extracts.

An analysis of Johnston and Gould's article shows that 23 different corpus luteum preparations were injected into 42 rats (Table I) and that 4 corpus luteum preparations were injected into 4 immature rabbits (Table II). The results were uniformly negative in both series.

The method of preparation of the corpus luteum extracts was according to the procedure described by Dowsy, Ralls, Allen and Johnston (J Biol Chem 1924 lxi 11) which may be summarized as a fractional extraction by means of alcohol, acetone and ether differing in but minor ways from the methods described by the pioneer Iscovesco in 1912 (Compt rend Soc de biol 1912 lxxix 202) and since then utilized with variations by practically all the workers on this subject.

Much emphasis is justly placed upon the employment of fresh ovaries in order to avoid post mortem diffusion and the shelling out of corpora lutea by skilled personelle in order to avoid inclusion of follicle fluid with the corpus luteum mass because this error would becloud the result.

The amount of tissue employed to obtain extract in the rat experiments varied between 10 and 60 grams. The authors do not state whether this

represents the amount given each animal or distributed among 1 to 6 animals nor do they record the amount of lipid obtained by extraction. Therefore no exact comparisons of our work and theirs is possible.

Table II which deals with the injections into normal immature rabbits will not be considered because in a previous paper Johnston as well as Allen, Dowsy et al (Am J Anat 1924 xxxiv 155) objected to my use of virgin rabbits *presumably adults* (the italics are mine) with ovaries intact. This addition of the phrase *presumably adults* is indeed pure presumption on the part of these authors as in a letter (J Am M Ass 1923 lxxxii 2133) in which I drew attention to another quotation of my work by Allen and Dowsy I specifically stated that I have used immature animals long before estrus could occur.

This letter was replied to by Allen and Dowsy and therefore noted. However to avoid any possibility of further misinterpretation misunderstanding or misquotation I will not refer to the numerous experiments performed on rabbits although their validity cannot be questioned but will confine my proof entirely to the smaller series of material tested on castrated rats by the vaginal smear method of Stockard and Papanicolaou.

In the subjoined table our positive results only are recorded but emphasis must be placed on the fact that in our preliminary work 47 batches or fractions proved negative. Twenty seven batches proved positive and after errors and pitfalls of preparation had been mastered all of the last 10 batches gave positive results.

As detailed in our article (J Am M Ass loc cit) we found the active female sex hormone present in all corpora lutea, most in yellow and least in the bloody or early corpus luteum. This seemingly bizarre fact is explained by the early vascularization of the yellow body immediately after follicle rupture which allows the hormone secreted by the corpus luteum cells to pass into the blood stream where we have demonstrated its presence (Frank, Frank, Gustavson and Weyerts J Am M Ass 1925 lxxxv 810) and prevents the corpus luteum from being a storage gland. Only when the capillary network begins to obliterate during involution (at the stage corresponding to the microscopic appearance of yellow) does storage of hormone temporarily occur.

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN M.D.  
ALLEN B. KANAHEL M.D.

Managing Editor  
Associate Editor

WILLIAM J. MAYO M.D.

Chief of Editorial Staff

APRIL 1926

### "KEEP THE HOME FIRES BURNING"

WHEN in January the surgeon takes account of stock with regard to the mortality results for the year just past, he is often chagrined over the finding that the percentage of deaths is greater than he had expected. But truth is stranger than fiction and occasionally (because he has been more impressed by his failures than by his successes) further investigation reveals that the results are really better than he had expected.

My brother counsels that when a patient writes a letter of praise it should not be read but that when a letter of the opposite type is received in which our cements are carefully depicted we should go over it with great care because we would probably learn something.

I have been reviewing our surgical work of last year. The deaths have been divided into three groups. In the first group are the 'too late' cases in which we did our best and in the light of our present knowledge could not do very much better if we had a second chance. In the second group are the cases in which our foresight was thoroughly discredited by

our hindsight. In other words if we had known in advance what we knew afterward some of these deaths might have been avoided. In the third group are the cases in which the general condition was bad but in some of which the patients might have lived if methods of rehabilitation had been carried out before operation.

It is to this problem of rehabilitation before operation in certain types of surgical cases that I have been giving thought. That my keen minded young colleagues have caused me to give thought to this subject and that I have been the agent by which the benefits of their researches have been conveyed to the patient would be the better way to put it.

Life is a matter of combustion, a union of the carbon of food with the oxygen of the air carried from the lungs by the red blood cell. It is only as oxidation takes place that vital processes can be maintained and of these processes the production of bodily heat and autonomic energy is fundamental. A patient can be placed in bed and kept so quiet that the production of energy is reduced to a minimum so far as the 25 per cent under conscious control is concerned but the fires must be kept burning to maintain energy in the vegetative system and to heat the body.

Hill in his classical experiments showed that the glycogen which is produced in the liver and which is merely glucose with one molecule of water abstracted is converted into lactic acid in the muscles of the controllable system at least that the accumulation of this acid in the muscles gives the sense of fatigue and that under violent exercise the lactic acid normally amounting in the

did not think it necessary to revise our galley proof as the results described in this and other papers which appeared after we had mailed our manuscript did not alter our conclusions.

The second deduction drawn by Dr Frank concerning our failure to obtain potent corpus luteum extracts is in complete accord with our conclusions.

In regard to the amount of extracted tissue injected we wish to state that each animal was considered individually and that the amounts stated were injected into one animal.

There can be no basis for comparison of Dr Frank's results with our own until the details of his chemical procedures are made available. Doisy et al (J Biol Chem 1925 100 43) clearly state their method of preparation and the number of rat units obtainable from a definite amount of material as well as the total amount of solids in each rat unit. We stated that we prepared our extracts after the same procedure used by Doisy et al and also give the weight and character of corpora lutea which failed to yield one rat unit.

As regards the freshness of the material used by Dr Frank we fail to find any reference to this important point. We feel that the only safe way to collect material for work such as is under discussion is an immediate removal of the corpora lutea from the ovary as it is removed from the freshly killed animal.

In regard to the discussion of the gestational gland we are forced to admit that we know nothing about the gland except as we have read of it from the articles of Frank and his collaborators. Aside from this source of information we can find no reference to this gland so that our discussion upon this point would not be very illuminating.

We cannot agree with Dr Frank in his closing statement about accepting his ideas regarding the gestational gland for even if we accept his statements as true the physiology of sex and reproduction remains more or less a puzzle and a rich field for careful and painstaking research.

St Louis Missouri

CHARLES G. JOHNSON  
VICTOR L. GOULD

# EDITORIALS

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blood from 0.02 to 0.03 per cent may be increased to 0.2 or even 0.3 per cent. It seems reasonable to suppose that production of energy takes place in the same way in the striated muscles. One of the most interesting side lights on this study of lactic acid is the reconversion of the acid ( $C_3H_5O_3$ ) in the muscles into glycogen ( $C_6H_{10}O_6$ ), as the oxygen debt is paid with a loss of one molecule of lactic acid in every five reconverted. It is interesting to note that two molecules of lactic acid make the glucose molecule ( $C_6H_{12}O_6$ ) with which we are familiar.

There is a large group of toxæmias secondary to various acute diseases such as the high intestinal obstructions in which the body can not convert foods into fuel and the fire goes down and often out. The drop in bodily temperature, low blood pressure, coldness and clamminess of the skin, small rapid pulse, dry tongue, and sordes on the teeth are tragic manifestations of a deadly toxicity.

Carbon, oxygen and hydrogen are the chief constituents of all food. Carbohydrates are the simplest form of fuel. Proteins in addition to carbon, oxygen and hydrogen contain nitrogen and usually a little sulphur. The nitrogen in some manner enables proteins to take on form and give stability to the tissues and permits the deposition of other elements such as calcium. Fats contain carbon, hydrogen, and a little oxygen but require a great amount of oxygen for conversion into fuel and the hydrogen is but slowly freed from the carbon. Fats serve an extraordinary purpose, however, producing not only heat but also water which explains the ability of the camel with its hump and of the hibernating animals with their autumn fat to go for long periods without food or drink.

The sugars are produced under normal conditions in the liver from the digested carbohydrates and are the cheap, easily obtained

fuel, the common coal of our existence. Glucose can be artificially produced outside the body in almost the form that it is used within the body. The conversion of the amino acids of the proteins, the anthracite coal of the body, into sugar is a slower process and more expensive and in the acute conditions under discussion usually means burning the body tissues and failure of elimination of the creatinin and urea, the ashes from the blood. The use of fat as a fuel to produce heat and energy is too slow a process to save life in acute conditions.

It has been pointed out by a number of observers, particularly by Matas, that the intravenous introduction of glucose solutions brings up the body temperature and gives to the vegetative system the energy necessary to life. Glucose given with large quantities of physiologic sodium chloride solution restores the chloride deficiency and also aids the elimination of the urea and creatinin. Now that we have by means of examination of the blood developed methods of precision for determining metabolic changes, many patients apparently moribund can be lifted out of the pit, so to speak, and enabled to undergo a life saving operation that would have been otherwise impossible.

W. J. Mayo

## DIATHERMY

**D**URING the last 25 years the position of electrotherapy in America has been one of almost total eclipse, largely because it had been allowed to fall into the hands of quacks, both in the profession and out of it, and because disciples of the various cults had recognized in it a means of widening their scope and increasing their prestige. Under such circumstances it was but natural that conscientious physicians generally should not only look askance at this method of treat-

ment but he prepared to condemn unheard any modifications of it. In Europe during the same period the situation was quite different because there electrotherapy had remained in the skilled hands of trained experts.

The war and its frightful mutilation of millions of human bodies provided an exceptional opportunity for testing out and demonstrating the usefulness of electrotherapy and physiotherapy. This demonstration made a strong impression on many American physicians who went to Europe to observe the methods employed in treating the wounded and since then a revival of interest in electrotherapy and physiotherapy has been evident. At the present moment this interest is largely centered on diathermy.

The painful sensations produced by passing an ordinary 60-cycle alternating current through the body are due to its relatively low frequency each alternating impulse being perceived as painful incomplete muscular contractions. If the alternating frequency is sufficiently increased painful contractions no longer take place and the only sensation is one of heat. Diathermy therefore is nothing more nor less than an improved method of employing heat as a therapeutic agent. It provides an almost ideal means of delivering as much heat as may be desired where it is needed. The heat may be diffused over the entire body or it may be concentrated through any region or at any point merely by changing the relative position and size of the opposing electrodes.

When diathermy is used to raise the temperature of some part of the body and the heat is not carried to the point of tissue destruction it is called medical diathermy. Surgical diathermy implies actual destruction of tissue by concentrating the heat at one point and can be varied within fairly wide limits by means of suitable electrodes.

The scope of medical diathermy will undoubtedly be enlarged but its value in many forms of inflammation without suppuration, such as sprains, simple arthritis and the inflammatory reactions accompanying fractures has been amply demonstrated. The exudates resolve repair is speedier and convalescence shortened. Myositis whether acute or subacute and neuritis respond extremely well. Certain forms of gonorrhoeal inflammation likewise yield quickly to the treatment. If nothing more could be said of diathermy than that it relieves pain and reduces swelling promptly, it would have a permanent place in therapeutics.

In the chronic forms of arthritis the effect of diathermy is not so uniformly striking in many cases partial or complete relief from pain and reduction of swelling are obtained, but in others the results are indifferent. If treated early trophic lesions due to vascular changes can sometimes be stopped and much damage prevented. General diathermy (autocondensation) greatly relieves the itching and insomnia associated with jaundice. In essential hypertension the blood pressure can be considerably reduced for several hours but this reduction is transitory. Diathermy has been advocated in pneumonia but it has not been given a serious trial.

The surgical indications depend largely on the expertness of the individual operator and range from keratotic patches warts moles melanomata and epitheliomata to relatively bulky superficial tumors or such as can be reached from the surface. The advantages of diathermy are that the cosmetic results are better that it can be repeated as often as necessary and that it minimizes hæmorrhage and malignant dissemination by causing thrombosis of the blood in the vessels and coagulation of fluids in and around the lesion treated.

Diathermy is *contra* indicated in suppurative conditions until provisions for adequate drainage have been made. The tendency to employ diathermy promiscuously and without real indications is to be deprecated, instead of diminishing the widespread influence of the cults it can only serve to increase those evils. The secret of the advantageous use of diathermy lies in the thorough understanding of the underlying principles, the careful selection of patients and the close attention to the many details of such treatment. In many patients diathermy alone is not sufficient to bring about the best results; it must be combined with other forms of electrotherapeutics or physiotherapy. Hence in any well organized clinic or hospital diathermy should simply form a part of the electrotherapeutic and physiotherapeutic armamentarium and should best be concentrated under one direction. Since the fundamental training of the radiologist enables him readily to master the principles of high frequency apparatus, he is specially designated to take up the method. In nearly all of the European clinics the radiologist and the electrologist are either one and the same person, or they are associated in the same department.

Recently an intensive commercial propaganda has led many physicians to take up diathermy without adequate preparation. The blame can hardly be placed on the manufacturers, who are actually in advance of the profession; it must fall on those who allow themselves to be induced to purchase such apparatus without knowing anything about the principles of its construction or about the proper application of the method. It is true that some of the manufacturers are offering short courses of instruction, generally covering one week. Of course it is obvious that all one can learn in that time is how to operate the apparatus and something about its construction, but the mere idea of physicians going to manufacturers of apparatus for information on the indications and contra indications for this or that form of treatment constitutes an anachronism. The growing vogue of electrotherapeutic and physiotherapeutic methods due to increased knowledge of their scientific basis and to better instrumentation makes it imperative that our medical schools reconsider the subject and provide sound courses of instruction. No longer should physicians have to seek such information at the shop of the instrument maker.

A. U. DESJARDINS



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A. U. DESJARDINS





JOHN T HODGEN  
1826-1882

# MASTER SURGEONS OF AMERICA

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## JOHN THOMPSON HODGEN

**J**OHN THOMPSON HODGEN was born at Hodgenville La Rue County, Kentucky January 29 1826 His father was Jacob Hodgen his mother Frances Park Brown His early education was received in the county school at Pittsfield, Illinois Later he attended Bethany College in West Virginia In March 1848 he graduated from the medical department of the University of the State of Missouri at that time known as McDowell's College He served as assistant resident physician and afterward as resident physician to the St. Louis City Hospital from April 1848 to June 1849

He began his work as a teacher in 1849 as demonstrator of anatomy in the Missouri Medical College was professor of anatomy in 1854 being appointed by Dr. Joseph Nash McDowell and filled this chair until 1858 Subsequently he filled the chairs both of anatomy and physiology from 1858 to 1864

During the Civil War he served as surgeon general of the Western Sanitary Commission as surgeon of the United States Volunteers from 1861 to 1864 and as surgeon general of the State of Missouri from 1862 to 1864 He was consulting surgeon to the St. Louis City Hospital from 1862 to 1882 and from 1864 until his death in 1882 he taught clinical surgery at the City Hospital

In 1862 he was called to the St. Louis Medical College filling respectively the chairs of physiology and anatomy On the resignation of Dr. Charles A. Pope in 1865 he was made Dean of the College which position he occupied until his death He was honored by the local profession as president of the St. Louis Medical Society in 1872 was chairman of the surgical section of the American Medical Association in 1873 and served as president of the Missouri State Medical Society in 1874 He was one of the original members of the American Surgical Association He was president of the American Medical Association in 1881

He died April 28 1882 after an illness of 2 days of acute peritonitis caused by a pin hole perforation of a small ulcer of the gall bladder

For 33 years Dr. Hodgen was a teacher A keen and accurate observer his interest was not limited to the sick room He was a student of nature quick to grasp and interpret its laws aright Alert to all the phenomena of life, his wonderfully active sympathy with every phase of human nature gave him powers of illustration which fixed facts in the mind of a hearer in a way to make them



truths not to be forgotten In the East and the West in the North and the South his fame as a teacher is a glory to St Louis He was exceptionally concise practical, and comprehensive As a teacher of surgery he was incomparable His influence was however impressed not only upon individuals it also controlled institutions As dean of the faculty of the St Louis Medical College he originated and consummated measures for its establishment on the basis of learning During the time that he was a potent factor in shaping its course the St Louis Medical College established an advanced standard of work which no other institution in St Louis dared to attempt until years later and then only under the pressure of enforcing laws

The high standard of the work of Washington University and the steady advance in the demands of the St Louis Medical College not only upon the students but upon the earnestness the unselfishness and the capability of the teachers finally led some years after the death of Dr Hodgen to the union of the two institutions in the way that he had anticipated and desired Dr Hodgen's last public speech was made before the alumni of the Washington University That speech was the echo of his life's striving a cry for 'more knowledge more light' As a surgeon he was conservative always but quick precise and dexterous The quick precision of his actions was but the outward sign of a mind singularly active and exact

The difficulties of a case never seemed to surprise or overwhelm his judgment He had resources at command adequate for any emergency His keen powers of observation ever on the alert quickly seized the phenomena of disease and with precision his analytical mind traced them to their causation and led him to just conclusions as to the nature of the disease and its rational treatment

He had, to a noteworthy degree mechanical genius which found play in the application of mechanical means to the uses of surgery Extensive observation with vast experience inspired his creative faculties which ever evolved original thought new methods and admirable instrumental inventions The most noteworthy of his inventions were—a suspension splint for fracture of the femur a modification of the Nathan R Smith anterior splint which was especially designed during the Civil War for the treatment of compound gunshot fractures of the femur—a suspension cord and pulleys which permitted flexion extension and rotation in fracture of the leg a forceps dilator for removal of foreign bodies from the air passages without tracheotomy a wire suspension splint for treatment of injuries or fractures of the arm a hair pin dilator for separating the lips of the opening in the trachea in tracheotomy an excellent adaptation of simple means to an end

Dr Hodgen's time was so fully taken up during the latter years of his life that his writings were not extensive Among his contributions were articles on 'Wiring the Clavicle and Acromion for Dislocation of the Scapular End of the

Clavicle " "Modification of Operation for Lacerated Penneum " "Dislocation of Both Hips " "Two Deaths from Chloroform " "Use of Atropia in the Collapse of Cholera, " "Three Cases of Extra Uterine Fetation " "Skin Grafting " "Nerve Section for Neuralgia " "Report on Antiseptic Surgery and " Shock and Effects of Compressed Air as Observed in the Building of the Eads Bridge "

Dr Hodgen had a big warm generous nature, well recognized by those who came to know him as he was but these qualities sometimes went unrecognized because of a somewhat reserved even austere manner He was full of a kindly humor His quick perception ready active and all pervading sympathy inspired and made strong friendships The poor and the afflicted looked with confidence to his helping hand The rich and powerful knew that they dealt with a just and humane man The city was rich in his presence He was a refuge in sorrow and sickness His fame as a surgeon was widespread

He made for himself a place unique in the profession No one before him had so clearly obtained first place in the hearts of the people and in the profession The conditions now existing can never evolve a man of such wide and varied capacity But man is for a brief time He was cut off in the prime of life in the zenith of his fame As a great teacher and a great surgeon he exemplified the genius of humanity whose qualities abide from generation to generation but speak only now and then in the process of time in the individual

He died as he had lived in the harness a friend to humanity He had always wished to go before his usefulness was in any degree impaired Honest frank direct a great soul We shall not see his like again H G Mudd

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED BROWN MD FACS OMAHA NEBRASKA

### ROGER OF SALERNO

**R**oger of Salerno more properly called Roger of Parma was the first outstanding surgeon of Italy to write a surgery and not depend upon the Arabian school for his ground work. He was born during the 12th century and probably lived into the 13th. It is likely that he produced his surgery which was known by various names during the latter part of the 12th century. Two names of the book are the *Practica Chirurgiae* and the *Post mundi Fabricam* the latter being derived from the first three words of the preface of the book. It was so far superior to anything that had appeared up to that time and contained so much original material for it does not contain any of the Arabic teaching that it was at once taken as one of the principal works for use in teaching at the school of Salerno. Thus it is one of the landmarks in surgery as it marks the breaking away of continental surgery from the influence of the Arabian school. The book was not wholly the production of Roger's thought but rather stated the opinions and beliefs of a new school of surgery which was founded on the work of the old Greek masters with the results of original observation added. Who his collaborators were is not definitely established as Roger does not mention them by name but states simply that others helped and he wrote the book. The detail of giving credit to others by name was frequently omitted about this time and a little later. Constantinus Africanus for example does not mention the source from which his work was obtained though much of his writing was word for word translation of such authors as *Haly Abbas Filius* *Costa Ben Luca* *Ishak Ben Soleiman* and others. Following Roger was his pupil *Roland* who rearranged his work and published it under his own name though he does give credit to his master. He does not state however that much of it is copied word for word. Whether this plagiarism was intentional or not it is hard to establish as the writings were handed down in manuscript form for nearly three centuries and there was thus considerable chance of error. In the case of Roger of Parma and his pupil *Roland* I have had the opportunity of making a comparison between an original manuscript of the thirteenth century (see illustration) and a printed book<sup>2</sup> of

1541. The manuscript is on vellum beautifully illuminated and is made up of 36 folios written in different 13th century hands. It contains among other things part of the surgery of Roger appearing under various headings. There is of course no title but above the initial letter is the statement: Here beginneth the surgery of master Roger. Then comes the famous introduction beginning with the lines by which it is known: *Post mundi Fabricam*.

After the formation of the world and setting it in order God made man of earthly substance and breathed the breath of life in him etc. Following the introduction is the table of contents and then the text of the book. The other volume carries us on a few centuries. It was printed by *Henricus Petrus* at Basle in 1541 and contains a book the title of which freely translated reads: A rational method of curing the ills of the human body internal and external written by *Roland*. Under the heading

*Praefatio* we read again the well known words: *Post mundi Fabricam* and so on. Going on further we find that save for an occasional word or change in phraseology the manuscript and book are the same. The disciple has taken the words of the master arranged them a little better and made the work more understandable. In some places he may have added a little new material but the chief change and one for the better is the arrangement. Roger did however write one part of surgery which remained his even to as late as the 16th century for we find in this volume of 1541 eight pages devoted to a description of phlebotomy ascribed to Roger under the title: *De Modis Mittendi Sanguinem et de cuiusque utilitate Rogeri chirurgi peritissimi Libellus*. In this work Roger gives the indications for phlebotomy and where the incisions should be made. For disease of the gums mouth or teeth he advises incision of two veins under the tongue. His indications are at first general and then methods are given in detail. In one general statement he says: of the hip tibia and foot we incise veins because of pain of the kidney and bladder and because of rheumatism sciatica and podagra and constriction of the eyes and swelling which affects the legs and feet or on account of withdrawal of the menses or when women do not conceive. The last two seem to be rather contrary indications. Roger well deserves to be considered the father of the new surgery in Italy if not in Continental Europe.

Courtesy of Dr. LeRoy Crumlin, Omaha, Nebraska.  
Courtesy of the John Crerar Library, Chicago.





## REVIEWS OF NEW BOOKS

THE modern tendency to present anatomy in more concise form is again exemplified in a little volume in paper covers which the authors, Pouchet and Dupret<sup>1</sup> rightly call a pocket anatomy. Although containing no text whatever the essentials of gross anatomy are very well covered in its 376 pages of simple well drawn pen and ink illustration—many of which are semidiagrammatic.

One cannot help but regret that the authors did not see fit to use the international or BNA terms in labeling the figures as the French terms used would tend to limit the book's usefulness to that country.

TOM JONES

**T**URNER'S little book<sup>2</sup> of seventy five pages with illustrations dealing with cancer surgery presents the substance of a lantern demonstration before the surgical section of the Royal Society of Medicine

The purpose of the writer is to draw from the wealth of his surgical experience such instances of the operative treatment and cure of cancer in its different situations as will serve to prove the axiom that the most certain and reliable method for the cure of cancer is the well executed surgical excision of the growth together with the path of probable cancer invasion while the disease is still local.

The cases have been observed for periods of from 5 to 16 years after operation and most of them have been supported by re-examination of the pathological material. Although few actual statistics are included the individual case histories are sufficient to accomplish the writer's purpose which is to encourage his younger colleagues to deal with cancer by vigorous and thorough operative measures. R B G

**PART IV** of *Lehrbuch der allgemeinen Diagnostik und Therapie sowie deren Verhütung* is now available. The work is divided into four parts. The first part which comprises 221 pages or almost exactly half of the book deals with mistakes and sources of error in roentgenological diagnosis and their prevention. This portion of the work includes some general remarks by Grashey of Munich a chapter on bone and joint diseases by Grashey one on the digestive organs by Lorenz of Hamburg one on lungs mediastinum and the diaphragm by Lorey of Hamburg one on the heart and blood vessels by Groedel of Frankfurt one on the urinary organs by Harnisch of Hamburg and one on foreign bodies by Grashey.

The second part 198 pages deals with errors and dangers in roentgenotherapy and their prevention.

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SOM E COUTURET t IN C NCE SOX x By G Grey T  
FR L S IN w York William Wood & Co 0 5  
LEARY MEB DE (L E MEB DIA MOTTIE UNB T A R BOWIE  
& L E VITON Edited by Prof D J Schw lbe N A J I  
mer de Koe ike diagnostia and Strahlenth rapie Edited by Prof Dr  
R Grab y Leipzig Georg Thieme 0 4

This consists of the following chapters. General considerations by Holfelder of Frankfurt surgical diseases by the same author gynecological diseases by Reifferscheid and Schupf of Goettingen skin diseases by Rost of Freiburg and internal diseases by Salzmann of Bad Kissingen.

The third part 24 pages is a discussion of errors in light therapy contributed by Jesionek and Rothman of Giessen.

The fourth part 21 pages is devoted to errors in radium therapy by Berven of Stockholm

In the portion dealing with roentgenological diagnosis mistakes in the technique of fluoroscopy as well as errors in the detail of roentgenography with the resulting confusion caused thereby are pointed out. The common errors in interpretation of the normal findings are discussed and the reasons for the mistakes emphasized. The causes of false interpretation of pathological conditions are similarly dealt with. Numerous diagrammatic but entirely satisfactory drawings are used to bring out the points.

The portion dealing with errors and dangers of roentgentherapy is of exceptional interest. Hof felder contributes an unusually valuable 75 pages discussing in considerable detail the poisonous action of roentgen rays, idiosyncrasy to roentgen rays, the latent period of the action of the rays, and the time required to determine the dose administered, the dose required, the disadvantage of administering too little and the dangers of excessive dosage, the dosage required for specific tissues, the effect of distance and the absorption in the tissues, filtration methods of measuring dosage, dosage in cross-firing, and other interesting information. The chapter ends with a consideration of the after treatment. His chapter on errors in roentgentherapy in surgical diseases is likewise of exceptional merit and of great practical value. In this chapter, as also in the chapters dealing with gynecological diseases, skin diseases, and internal medical diseases, the questions of the indications for value of details of technique of administration and dosage symptoms to be expected and results that may be gained are gone into in the minutest detail, so that this portion of the work constitutes a valuable handbook on this subject. The chapters dealing with light therapy and radium therapy are less extensive but contain many valuable practical points.

The work as a whole is highly practical, clear cut and to the point. The usefulness of the book is enhanced by a very good general index and each chapter is preceded by a carefully prepared list of contents. The only criticism of the volume is the absence of a complete bibliography, however this would require too much space to be practical. Holfelder's chapters are the only ones which are followed by a bibliography.

The book is of exceptional interest and should be consulted by physicians and surgeons as well as roentgenologists  
DAVID C. STRAUS

DAVID L STEALS

THE second volume of this elaborate three volume work on the clinical aspects of malignant tumors fully justifies the good opinion expressed in these columns concerning the first volume. The entire set covers in great detail an enormous field of the greatest practical significance to the surgeon. The various chapters have been written by men who are recognized masters in their specialties and who have brought their respective subjects down to date with many references to the literature of 1924. It is therefore worthy of an important place in the library of every surgeon. The editors and publishers are to be praised for the rapidity with which the several volumes of so compendious a work are being published. Volume I having appeared late in 1924. Volume II in June 1925.

This second volume contains 722 pages with 48 full page colored plates and 267 illustrations which are of exceptional excellence.

The editors P Zweifel and E Fayr<sup>1</sup> of Leipzig point out in their introduction that the best proof of the timeliness and the necessity of a clinical presentation of malignant neoplasms is presented by Lubarsch a statistical study covering 86 216 necropsies in 98 per cent of which cancer was diagnosed postmortem. The errors in the clinical diagnosis of external cancer amounted to 8.26 per cent of which 5 per cent were mistakes as to the nature of the tumor and 3.26 per cent as to the location. The total errors in diagnosis of tumors of internal organs were 32.44 per cent or almost one third of the total number of diagnoses of these 37.35 per cent were mistakes as to the nature of the tumor and 15.09 per cent errors as to the location of the primary neoplasm. The mistakes in diagnosis of sarcoma of internal organs amounted to 43.23 per cent. That this condition is not peculiar to Germany is evident from Wells' recent review of similar statistics (J Am Med Ass 1923 lxxx 737-740).

The editors point out that these discrepancies between clinical diagnosis and postmortem findings persist in spite of the most modern methods employed. Efficient treatment of malignant tumors is only possible on the basis of early diagnosis both as to the nature of the tumor and the organ primarily involved. To furnish criteria for such correct diagnoses is the principal purpose of this work.

The material presented in this volume may be indicated by the following brief summary. The

indicated by the following:

DIE KLINIK 20 SARTI 24 GESCHULTER P Zw 11 d E  
P Yr Vol II Brust d Bauchg H und m anl h Ge-  
Leitung S Hugel

article on tumors of the bronchi lungs pleura mediastinum (thymus) heart and pericardium, chest wall and diaphragm was written by Franz Krampf and F Sauerbruch that on the oesophagus by E Rehn on the abdominal wall by E Sonztag Otto Kleinschmidt wrote the chapter on the pathological anatomy diagnosis symptomatology and differential diagnosis of carcinoma of the stomach Payr that on the treatment of carcinoma of the stomach Victor Schmieiden contributed the article on tumors of the intestine and P Clairmont that on tumors of the rectum Malignant tumors of the liver gall bladder bile ducts pancreas and spleen are discussed by E Heller and malignant tumors of the kidneys renal pelvis ureters and adrenals by H Kucsmann F Voelcker and H Boerninghaus present the malignant tumors of the bladder urethra testicles and epididymis prostate seminal vesicles and penis N Guleke the malignant tumors of the spinal column and I Frangenheim the malignant tumors of the extremities The volume closes with a chapter by Frangenheim on the relation of tumor formation and trauma Each chapter is followed by a bibliography in which few references are given to papers by American workers

The typography and general appearance of the two volumes thus far published are quite in keeping with the very high quality of their contents. Contributors, editors and publishers are entitled to high praise for supplying the profession with these works.

L. M. ZIMMERMAN

A MONOGRAPH<sup>1</sup> on the subject of malignant disease of the testicle by Dr Dew comprises a complete review of the literature and the author's observations of the study of 40 hitherto unreported cases of the disease. The book is of special interest to pathologists and to clinicians whose specialty may give them access to more than an occasional case. In the classification of these tumors there are two main types (1) the teratoma in which any one of the three types of cells may become malignant and tend to obscure the presence of the other two and (2) the pure carcinoma which arises from cells of the seminal epithelium. In the treatment the point is stressed

In the surgical treatment the point is stressed that simple orchidectomy is inadequate in most instances but must be done in conjunction with a complete removal of the lymph chains and nodes known to be regularly and early involved.

Good anatomical pathological and surgical  
HARRY CLIVER

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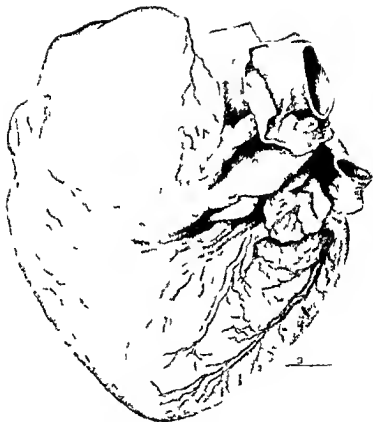


Plate I Hydatid cyst of the heart a boy of 9 years

*Hydatid Cysts in Children — H. W. Mills*

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

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## HYDATID CYSTS IN CHILDREN

WITH REPORT OF THREE CASES

By H. W. MILLS M.R.C.S. (Eng.) L.R.C.P. (Lond.) F.A.C.S. SAN BERNARDINO, CALIFORNIA

AS DÉVÉ has pointed out the seeds of echinococcosis are sown in infancy and it is the extreme latency of the disease which is responsible for the fact that the majority of hydatid cysts cause no symptoms until the patient has attained the age of from 20 to 40 years. To this latency there are of course for mechanical reasons exceptions thus the average age at which hydatid cysts of the heart have been reported (and all such cases up to now have been autopsy findings) is twenty three. Again hydatid cysts of the brain are seen seven times as often in children as in adults this situation being third in point of frequency in children as against eighth in adults (the exact figures are 4.3 per cent in children and 0.6 per cent in adults (Dévé)). The end results of surgery here are relatively inefficacious though Castro had a case well 5 years after operation (Lagos Garcia who quotes four personal cases). The immediate results however so far as life is concerned are surprisingly good as Lendon pointed out as far back as 1903—50 per cent recoveries. For similar reasons i.e. mechanical ones hydatid cysts of the orbit invite an early diagnosis (Solares child aged 6 C. D. Marshall girl aged 5 Cunco girl aged 5 Machlowzowa child aged 2 Cabaut child aged 2 Rudolph 4 months old baby) though even here the extreme latency of the disease is shown in the case of Demichien quoted by Santanowsky,

in which the evolution extended over 10 years. Santanowsky also quotes the case of Papaioanon (cited by Demichien) of a boy aged 12 who had had an orbital tumor for 6 years.

Dévé has laboured the fact that in children the hydatid cyst is a simple one without complication whereas in adults it is already an old one. Lagos Garcia found daughter cysts in only 23 out of 274 cases in children and such cysts were never found in the lung or kidney. Therefore if one wants to study the disease in its uncomplicated form it is well to do so in a child under 15 years of age pathology gleaned from adults is here misleading.

Passing over as open to doubt the so called congenital cases (Cruveilhier hydatid cyst of the liver in a 12 days old infant Heyfelder multiple hydatid cysts of the placenta and cord in a 7 months old fetus Hemmer abdominal echinococcosis in a fetus causing dystocia) we come to the possibly authentic cases of Arquellada (abdominal cyst in a 7 months old infant in which the pathologist reported the finding of hooklets) and Rudolph (hydatid cyst of the orbit the size of a hens egg in a 4 months old baby). Vegas and Cranwell however state that there is no authentic case in a sucking infant.

As a matter of fact it is natural that children should be more likely than adults to contract the disease for the intimacy of children with dogs is notorious as also is their hygienic

carelessness. The affection is undoubtedly rare up to the age of 4 but markedly increases up to the age of 8. At the age of 3 however 8 cases have been reported by Vegas and Cranwell 12 by Lagos Garcia 4 by P de Pena and Posadas reported the case of a hydatid cyst in the brain of a child of this age which had caused symptoms for a year.

At the age of 2 hydatid cysts have been reported by Machlowzowa (orbit) Cabaut (orbit), Penic (neck) and Lagos Garcia (liver). Kapsammer had a small patient aged 9 who had passed hydatid cysts in the urine since the age of 6 months (Dévé).

The great majority of early cases can be explained by precocious extra uterine contamination.

In South America, where extreme familiarity with the disease renders early diagnosis the rule, the frequency in children under 14 years old is well recognized. Vegas and Cranwell giving the incidence as 26.2 per cent and Prat of Uruguay as 23 per cent. It should be stated however that the more recent statistics of Greenway<sup>1</sup> based on 2,740 cases showed an incidence of only 11 per cent in children under the age of fourteen and 0.54 per cent for children under the age of four. This drop is probably due to the excellent prophylactic propaganda which has in late years been carried on.

Because the hydatid cyst in the child is a young cyst it is univesicular in over 90 per cent of cases (Dévé, 90 per cent. Lagos Garcia 91.6 per cent, P de Pena 92 per cent).

Again as a hydatid cyst in man usually remains sterile until it becomes the size of a hen's egg, acephalocysts are common in children. Another point to note is that the proportion of suppurating cysts rises with the age of the patient (Dévé 1917). It is twice as frequent in adults as in children, the exact figures are 13.8 per cent for adults as against 5.9 per cent in children (Vegas and Cranwell). Lagos Garcia remarks that while suppuration is very rare it is nevertheless the commonest complication in children, the lung being the most frequent site. For the same reason because it has not had time to develop secondary abdominal echinococcosis is twice as rare

in children as in adults and this although hydatid cysts of the liver have a greater tendency to rupture into the abdominal cavity in children than in adults. In this connection it may be mentioned that such rupture in children frequently passes unnoticed for many years.

As regard diagnosis large symptomatic liver lesions present an easier problem in children than in adults because such conditions as cancer, syphilis and the various forms of cirrhosis can usually be ruled out. There are however exceptions to this statement thus sarcoma of the liver, fibrosarcoma of the costal margin, gumma of the liver and hepatic hypertrophy of cardiac origin (Morquio) have all been mistaken for hydatid cysts.

Eosinophilia is notoriously inconstant in children and the complement fixation test fails in 10 per cent of cases.

As regards treatment the young simple cyst of the child lends itself more readily to the closed method than does the old and often complicated cyst of the adult. Lagos Garcia advocates it in the absence of pycnestic suppuration or daughter cysts, he practices fixation to the abdominal wall and points out that in suitable cases a cure may be effected in 10 days.

In the case of the lung however the prognosis is as a matter of fact worse than in the adult (Dévé). Hydatid infantilism has been described by Dévé who reported five cases in 1920.

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The extreme latency of the disease has been referred to above, exact details however in this respect are difficult to arrive at in man and even more so in animal. Generally speaking such cysts grow quicker in children because of the succulence of the latter. Incidentally for the same reason it is much easier experimentally to inoculate young animals than old ones.

In the case of the lung Escudero has pointed out that an hydatid cyst is not likely to attract attention until it has existed for at

least 2 years. An hydatid cyst grows more quickly for mechanical reasons in the lung than in the liver. 76.2 per cent of hydatid cysts in children are situated in the liver.

An Australian surgeon (MacLaurin 1914) has drawn attention to the connection between the incidence of hydatid cysts in man and plentiful rainfalls, the latter occurring about every 6 years. Isolated instances in which it was possible to gauge the latent period have been recorded by Watson. 2 years. Cudmore. pentoneal cyst. 30 years, Phillips (Canal Zone) hydatid cyst of the pancreas in a Russian male. probable duration 33 years. infected at the age of two. Horand (cited by Desplas Boppe and Bertrand) hydatid cyst of the bone. 39 years.

It is not therefore difficult to understand and accept Deves' statement. Echinococcosis is a disease of early life—age of infancy.

#### DISTRIBUTION OF ECHINOCOCCOSIS IN CHILDREN

While scattered records of hydatid cysts in children are found in the literature of all nations, it is to certain parts of South America that one must go for clinical material on a large scale. The abundance of the latter in Buenos Aires and Montevideo is such that the leading surgeons there are all experts in the matter. And in so far as the disease especially affects children, such men as Lagos Garcia de Pena and Morquio are world wide recognized authorities.

From such a wealth of material it is obviously possible in a paper of this kind to select for mention only a few illustrative cases. The following reports from the various countries of the world are, with a few exceptions, comparatively recent, by which I mean that they are subsequent to the only exhaustive review of echinococcosis in this country—that of Lyon published in January 1900.

*Argentina.* D. S. Cunco reported 9 cases, 1 of the orbit in a girl aged 5, 1 of the ovary in a girl aged 15 and 7 of the liver in children aged 10 to 15.

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Navarro and Finocchio's case of multiple hydatid cysts of the liver in a girl aged 9 was notable in that from 80 to 100 cysts were present. The left lobe only was operated upon, as it was the least affected. Twenty five cysts of the size of a nut to a hen's egg were treated by the closed method and the patient recovered. The authors regard this as an example of secondary echinococcosis from intra-hepatic rupture of a liver cyst without pentoneal infection.

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Navarro and Finocchio's case of multiple hydatid cysts of the liver in a girl aged 9 was notable in that from 30 to 100 cysts were present. The left lobe only was operated upon as it was the least affected. Twenty five cysts of the size of a nut to a hen's egg were treated by the closed method and the patient recovered. The authors regard this as an example of secondary echinococcosis from intra-hepatic rupture of a liver cyst without peritoneal infection.

Mumagurria reports a hydatid cyst of the lung in a boy aged 13, the boy was operated upon successfully by the Lamas Prat Mondino technique.

carelessness. The affection is undoubtedly rare up to the age of 4 but markedly increases up to the age of 8. At the age of 3, however, 8 cases have been reported by Vegas and Cranwell, 12 by Lagos Garcia, 4 by P. de Pena and Posadas reported the case of a hydatid cyst in the brain of a child of this age which had caused symptoms for a year.

At the age of 2 bydatid cysts have been reported by Machkowszewska (orbit), Cabaut (orbit), Pencic (neck) and Lagos Garcia (liver). Kapsammer had a small patient aged 9 who had passed hydatid cysts in the urine since the age of 6 months (Dévé).

The great majority of early cases can be explained by precocious extra uterine contamination.

In South America where extreme familiarity with the disease renders early diagnosis the rule the frequency in children under 14 years old is well recognised. Vegas and Cranwell giving the incidence as 26.2 per cent and Prat of Uruguay as 23 per cent. It should be stated however that the more recent statistics of Greenway<sup>1</sup> based on 2,740 cases showed an incidence of only 11 per cent in children under the age of fourteen and 0.54 per cent for children under the age of four. This drop is probably due to the excellent prophylactic propaganda which has in late years been carried on.

Because the hydatid cyst in the child is a young cyst it is univesicular in over 90 per cent of cases (Dévé, 90 per cent. Lagos Garcia 91.6 per cent. P. de Pena 92 per cent).

Again as a hydatid cyst in man usually remains sterile until it becomes the size of a hen's egg acephalocysts are common in children. Another point to note is that the proportion of suppurating cysts rises with the age of the patient (Dévé 1917). It is twice as frequent in adults as in children the exact figures are 13.8 per cent for adults as against 5.9 per cent in children (Vegas and Cranwell). Lagos Garcia remarks that while suppuration is very rare, it is nevertheless the commonest complication in children the lung being the most frequent site. For the same reason because it has not had time to develop, secondary abdominal echinococcosis is twice as rare

in children as in adults and this although hydatid cysts of the liver have a greater tendency to rupture into the abdominal cavity in children than in adults. In this connection it may be mentioned that such rupture in children frequently passes unnoticed for many years.

As regards diagnosis large symptomless liver lesions present an easier problem in children than in adults because such conditions as cancer, syphilis and the various forms of cirrhosis can usually be ruled out. There are however, exceptions to this statement thus sarcoma of the liver, fibrosarcoma of the costal margin, gumma of the liver and hepatic hypertrophy of cardiac origin (Morquio) have all been mistaken for hydatid cysts.

Leishmanophilia is notoriously inconstant in children and the complement fixation test fails in 10 per cent of cases.

As regards treatment the young simple cyst of the child lends itself more readily to the closed method than does the old and often complicated cyst of the adult. Lagos Garcia advocates it in the absence of pericystic suppuration or daughter cysts he practices fixation to the abdominal wall and points out that in suitable cases a cure may be effected in 10 days.

In the case of the lung however the prognosis is as a matter of fact worse than in the adult (Dévé). Hydatid infantilism has been described by Dévé who reported five cases in 1920.

Lagos Garcia noted hydatid fremitus in 8 of his cases (7 liver and 1 secondary abdominal cyst). He reported 1 case of hydatid enteric. He noted that miliary tubercles in children may be indistinguishable from pseudotuberculous echinococcosis.

The extreme latency of the disease has been referred to above exact details however in this respect are difficult to arrive at in man and even more so in animals. Generally speaking such cysts grow quicker in children because of the succulence of the latter. Incidentally for the same reason it is much easier experimentally to inoculate young animals than old ones.

In the case of the lung Escudero has pointed out that an hydatid cyst is not likely to attract attention until it has existed for at

Adam quoted a postmortem case of echinococcus bavarotyrolienne in an idiot boy from Ain who was accustomed to eat slugs frogs etc. This was the third case of this rare disease observed in France the first case having been reported by Hayem of Paris in 1860 and the second by Demateis of Genoa in 1890. A fourth case has since been reported by Mallard and Favre of Lyon.

Lavillat reported two cases. Hydatid cyst of the lung in a girl aged 9. operation recovery. Hydatid cyst of the lung in a boy aged 10. spontaneous cure by vomica.

Bertrand and Medacovitch published the post mortem case of a hydatid cyst of the brain in a boy aged 15. Practically the whole of the left cerebral hemisphere was destroyed.

Rocher and Masse recorded the case of an hydatid cyst of the liver in a boy aged 7. The complement fixation test was negative and eosinophilia not increased. He was operated on by the closed method and rapid recovery resulted.

Nove Jossierand reported the case of an hydatid cyst of the iliac bone in a girl aged 13½. The picture suggested cystic osteosarcoma. Operation death.

Italy Chelini published the case of a baby aged 5 with an hydatid cyst of the right lung. Operation consisted of cutaneous incision of Schede resection of 4 centimeters of seventh and eighth ribs incision of pleura and suture of parietal to visceral layers pneumotomy with cautery evacuation of cyst contents. The wound healed on the twenty eighth day.

Longo recorded the case of an echinococcus cyst of the kidney in a girl aged 7. The tumor was the size of a child's head. Eosinophilia 60 per cent. Marasmus for 5 months but no urinary symptoms. At operation the contents including one daughter cyst were removed and the cavity packed with gauze. Fever for 20 days. Good recovery.

Fioravanti saw three cases. The first was that of a child aged 3 with an echinococcus cyst of the left lobe of the liver. Marsupialization was done and child discharged in 50 days. In the second case an hydatid cyst of the mesentery in a boy aged 14. an incision was made and foetid pus containing daughter cysts evacuated the cavity was packed with iodoform gauze and patient was discharged cured in 2 months. The third case a child aged 3 had a hydatid cyst of the transverse mesocolon which contained daughter cysts. Marsupialization was done and child discharged cured in 45 days.

Iavarone recorded the case of an echinococcus cyst of the liver in a boy aged 6. he was operated upon and cured.

In Lama's case the X ray demonstrated typical hydatid cyst in the left lung of a boy who had been ill for 6 months. Casoni positive. Operation resulted in recovery.

Baccarini described an hydatid cyst the size of a hen's egg in the left side of the neck in a boy aged 10. Hooklets were demonstrated. Out of 116 cases of hydatid disease in children in the services of Morquio and de Pena only 3 were found in the neck.

Genoese published the case of a girl aged 7 with hydatid cysts in both lungs. Biological tests all failed but the X ray cleared up the diagnosis. Cysts in one lung were successfully operated on those in the other lung were left for a future occasion. In Thorstensen's 920 cases in Iceland only 4 were in children aged from 4 to 10.

Sabatini's case was that of a boy aged 14 with an hydatid cyst of the brain which ruptured into the longitudinal sinus. Severe anaphylaxis urticaria cyanosis dyspnea collapse death.

Australia The prevalence here of the disease can be judged by the size of the personal statistics. Thus Barnett reported 302 personal cases. MacLaurin had had up to 1907 140 personal cases of hydatid cysts of the liver. He mentioned that 70 cases were operated on in Sydney in 2 years and that the disease was uncommon until 20 years before. K. D. Fairley stated that from 1908 to 1911 258 verified cases were admitted to the Melbourne Hospital. O'Hara referred to several hundred personal cases but thinks that the disease is less prevalent in Victoria than it was 30 years ago. The list of cases here selected must necessarily be brief.

Ritchie recorded 2 cases in children. The first was that of an hydatid cyst of the lung in a boy aged 11. operation cure. In the second an hydatid cyst of the liver in a girl aged 7 had been removed in 1899 subsequently cysts in the right buttock and below the left costal arch appeared the cyst in the buttock disappeared after traumatic rupture.

Joske described the case of an hydatid cyst at the apex of the left scapula in a boy aged 9. The cyst was suppurating and contained daughter cysts and fragments of bone. The tip of the scapula was necrotic and two contiguous ribs were fractured. This was the only case the author had seen of fracture of the rib from hydatid disease.

Anderson published the case of an hydatid cyst of the lung in a girl aged 7. Operation the cyst contained foetid pus and communicated with the bronchi. There were no daughter cysts. Recovery resulted.

Vercos and Poulton reported hydatid cysts of the brain and heart in a boy aged 14. The brain cyst was operated upon in two stages. The temperature rose to 105 degrees F on the seventh day and death occurred on the fifteenth day. Postmortem two other cysts were found in the brain and one in the heart.

J. Ramsay saw over 100 cases of hydatid disease in Tasmania in 17 years. He quoted the case of an hydatid cyst of the liver in a girl aged 4. The common duct was blocked by daughter cysts.

Ryan described an hydatid cyst of the brain in a girl aged 6½. A tympanic note on percussion of skull was noted. Operation was done in two stages. The cyst occupied a large part of the left cerebral hemisphere. The bone was not replaced. A small rubber drain was inserted. Recovery occurred. Eleven weeks after operation the optic neuritis had disappeared and speech was almost normal. There was still some right foot drop.



Rivarola refers to 21 operative cases of hydatid cysts of the brain in children 8 were cured 13 died a mortality of 61.9 per cent

*Uruguay* Fournier reported intraspinal hydatid cysts in a boy aged 12. He had sudden paraplegia. X-ray examination showed rarefaction of the fifth dorsal vertebra and of the sixth rib. He was operated upon successfully. This condition may be confounded with primary vertebral osteitis.

*Ponce de Leon* reported a case of death following lumbar puncture for a hydatid cyst of the brain in a boy aged 11. An enormous hydatid cyst occupied almost all the right parietal and occipital lobes. In the discussion Morquio mentioned a case in which progressive blindness was the only symptom.

R. Gomez recorded the case of an hydatid cyst of the liver with intraperitoneal rupture and insemination. One year later multivesiculation of the liver cyst (Dévé's defense reaction) was found to obtain and the free edge of the omentum which was adherent to the liver cyst was full of tiny cysts from the size of a grain of sand to that of a hazelnut. It might have been well in this case to wash out the abdominal cavity with ether on the occasion of the rupture of the liver cyst.

Pelfort (service of Morquio) described an hydatid cyst of the lung cured by vomica in a boy aged 11.

Alice A. Ugón reported the case of an hydatid cyst of the lung cured by spontaneous vomica in a boy aged 6.

L. Morquio published the following cases. Hydatid cyst of the brain in a girl aged 12. Hydatid cyst of the brain in a boy aged 11 operated upon in two stages death the next morning. postmortem hydatid cyst the size of a fetal head in the right hemisphere. Hydatid cyst of the brain in a girl aged 13, who died the day after operation. Hydatid cyst of the brain in a girl aged 10. complement fixation test and Casoni negative no eosinophilia. He points out that in these cases the value of the complement fixation test has been exaggerated. Latency may extend to years. They are usually single. Rarely are daughter cysts found. The size of the cyst may be enormous. Operation is useful in the case of small superficial cysts with central cysts it is usually fatal. In only one of his brain cases (boy aged 6) was operation successful. In a few months he saw seven certain cases and three in which he suspected hydatid cyst of the brain in a few months. He confirms the usual absence of increased eosinophilia in cases of hydatid cysts of the brain. The author quoted three personal cases of hydatid cysts of the neck in children.

*Spain* A. Martin recorded the case of a retrovesical hydatid cyst in a boy aged 13. Treatment by aspiration of contents through the rectal wall was successful in this as in three other cases.

Coronas reported two cases. One was an alveolar echinococcosis of the liver in a boy aged 8 the first case observed in Spain. The pre-operative diagnosis was multilocular hydatid cyst. The postoperative diagnosis was multiple inoperable hydatid cysts. At

postmortem 22 cysts were found in the liver. Cysts were also found in the spleen, kidney and lung and a subcutaneous one in the left leg. Pathological report echinococcosis alveolaris. The other patient a boy aged 9 had a single small hydatid cyst of the liver with enlargement of the liver and spleen and intense icterus which lasted for 5 years. A tumor could be seen through the abdominal wall. Post-operative diagnosis unilocular hydatid cyst. The author mentions a case in which he mistook a lipoma of the leg for a hydatid cyst on the strength of marked eosinophilia and positive complement fixation test.

Cardenal and Castella published the report of a case of a hydatid cyst of the brain in a boy aged 14. On decompression over the left Rolandic region multiple hydatid cysts poured out of the opening. The membranes were extracted and the cavity packed with gauze which was all removed by the sixteenth day. Practically complete recovery ensued. Symptoms of epilepsy which had obtained before the operation disappeared. One subsequent convulsion occurred 7 months after operation. The ultimate prognosis is not good in these cases.

Noguera described hydatid cysts of the neck in two children aged respectively 6 and 12. The latter patient had a primary hydatid cyst of the liver also. The treatment adopted was formolage, evacuation and suture.

De la Mata recorded the case of an hydatid cyst of the sternomastoid in a boy aged 4. excision cure.

J. Garcia del Diestro published the case of an hydatid cyst of the lung in a boy aged 13 whose appearance was tuberculous. He had dyspnea. Eosinophilia was 3 per cent. Complement fixation test was negative. Vomica occurred the night before he was to have been operated upon. Urticaria and pleuritis were noted on the fourteenth day and he spat up hydatids on the sixteenth day. On the twenty-second day eosinophilia 30 per cent obtained and the complement fixation test was positive. Ultimate results were good. Hemoptysis is an important symptom here as it is unusual in infantile tuberculosis. This is an example of spontaneous cure by vomica.

*Brazil* Max Rudolph reported the case of a Portuguese baby aged 4 months with an hydatid cyst of the orbit. An enormous tumor the size of a hen's egg developed in 16 days. The eyeball was intact. The fluid contained succinic acid.

*France* Beauduin recorded the case of an hydatid cyst of the brain in a boy aged 15. The operative mortality in 36 cases collected by the author was 71 per cent.

Verdelet published 3 cases of hydatid cysts in children. The first was that of a girl aged 8 with a parenchymatous hydatid cyst operation cure. The second a Belgian boy aged 10 with a hydatid cyst of the neck operation cure. The third a Belgian boy aged 11 with multiple hydatid cysts of the abdomen. Ablation of 12 cysts was done death occurred from shock 36 hours later.

seldom more than three obtain and that their origin is usually due to dissemination of the component parts of the primary cyst

*Holland* De Jager reported the case of an echinococcus cyst of the lung and liver in a child aged 4 both cysts were removed at operation

Verschoor saw a case of an hydatid cyst of the lung in a child Eosinophilia 20 per cent hooklets in sputum complement fixation test positive X ray demonstrated an hydatid cyst in each lung There was no history of association with dogs

*Switzerland* Curchod quoted the case of a boy aged 15 who had twice been operated on by Roux for peritoneal echinococcosis and who died from generalization of the disease He also mentioned the case of Kolbe that of a boy aged 7 with a suppurating hydatid cyst of the liver Many necrotic daughter cysts were encountered Operation marsupialization

#### HYDATID CYSTS IN CHILDREN IN NORTH AMERICA

Lyon's review of the subject (up to July 1 1901) contained 5 cases of hydatid disease in children (Case 2 boy aged 10 abdominal hydatid cyst Case 95 girl aged 12 brain Case 103 Icelandic girl aged 10 five cysts in the liver Case 129 child with many cysts in its bladder, hooklets demonstrated Case 146 Italian boy aged 7 two large cysts of the liver containing daughter cysts) In a footnote (p 131) he stated that Ferguson saw 3 cases in children under 5 years of age who had been brought to Winnipeg by Icelandic immigrants This makes 8 cases in all for North America

Since the publication of Lyon's paper three more case reports have appeared

CASE 1 CHENEY Italian boy aged 7 hydatid cyst of the liver two stage operation recovery

CASE 2 CHENEY An Italian boy aged 10 born in Argentina where he was intimate with dogs had a hydatid cyst of the liver no daughter cysts Recovery fistula healed very slowly

CASE 3 H M YOUNG (Canada) Girl aged 9 came to Canada at the age of 2 from Southern Russia where she had contracted the disease An hydatid cyst of the right lobe of the liver the size of a grapefruit and one in the quadrate lobe the size of an orange were found The cysts were evacuated and packed with gauze Both contained daughter cysts Hooklets were demonstrated

To these I now add three cases which have not been previously reported

CASE 4 (Courtesy of Dr Emmet Rixford of San Francisco 1897) Hydatid cyst of the liver in a boy aged 6 He had had fever four years before

and enlargement of the right side of the abdomen for 3½ years At operation April 11 1897 an hydatid cyst of the liver containing one pint of fluid was found Marsupialization was done Three days later many daughter cysts discharged with membranes Recovery A second cyst was discovered evacuated and drained recovery June 7 1897 patient discharged with wound soundly healed

This case was not included in Lyon's list

CASE 2 (Courtesy of Dr Norman F Sprague of Los Angeles) Boy aged 13 born in Scotland had lived 10 years in America At first operation in 1900 multiple cysts of omentum were resected

At second operation multiple cysts of liver were resected *en masse*

At third operation recurrences in pelvis were resected

The result was an apparent ultimate cure Patient is now quite well and working with no evidence of recurrence In this case hooklets were demonstrated there was no eosinophilia

CASE 3 (Courtesy of Dr Hugh K Berkeley of Los Angeles) Russian boy aged 7 who had lived all his life in Los Angeles At operation (1923) a unilocular hydatid cyst of the liver the size of a baseball containing 6 ounces of fluid was found The treatment adopted was marsupialization and drainage Typical laminated membranes and scolices were demonstrated The patient recovered

Thus the total number of cases of hydatid cysts in children for North America to date is only 14

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Pitts reported the case of a girl aged 5 who died suddenly after a fall on her abdomen. Postmortem two hydatid cysts of the liver the size of a tangerine and cricket ball were found one had ruptured into the inferior vena cava. The right auricle and ventricle were filled with hydatid membrane. Death from massive embolism occurred.

Cudmore recorded the case of an hydatid cyst of the liver in a child aged 4 operated on by the Thornton method. The wound healed on the seventh day. On the eighteenth postoperative day the incision was found to be bulging and one ounce of bile stained pus was let out.

Watson stated that he had seen 3 cases of hydatid cysts in children under 4 years of age each of which was as large as a child's head.

*British (other than Australia)* Colman saw a postmortem case of an hydatid cyst of the spinal cord in a boy aged 10.

Dalton described the case of an hydatid cyst of the liver in a girl aged 11. Hydatidemia was observed also the discharge of daughter cysts via the bronchi. Follow up history at the age of 16 her abdomen was frequently tapped. She was well thereafter for 6 years. At the age of 23 she died from septic peritonitis. Postmortem an old hydatid cyst of the liver was found communicating with the bile ducts and with a dilated bronchus.

Stiles recorded the case of an hydatid cyst of the liver in a boy aged 8 from Shetland. Operation recovery. He also had a case of hydatid cyst of the liver in a girl aged 9 who came from Shetland. Symptoms for 3 years no history of association with dogs. Hydatid fremitus marked. At operation three fourth gallon of clear fluid and one daughter cyst the size of a Bantam's egg were evacuated. Marsupialization and drainage was the treatment adopted. An hydatid rash appeared and lasted for 48 hours. Recovery.

Ashby published the case of an hydatid cyst of the brain in a boy aged 8½ who died comatose. Postmortem a large unilocular hydatid cyst in the right frontal lobe was found. Scolices were demonstrated. The first focal symptom (except focal pain) was twitching of the face on the same side as the lesion. The cyst bulged medially and compressed the face center of the opposite side.

Marshall described the case of an hydatid cyst of the orbit in a girl aged 5. Operation cyst easily enucleated. No scolices were found. Typical laminated membrane was demonstrated. Complete recovery with normal vision resulted.

Owen (Melbourne) saw a case of hydatid cyst of the spine in a girl aged 13. Laminectomy of sixth, seventh and eighth dorsal vertebrae was performed. Daughter cysts were found. The wound was closed without opening the dura.

Cottenhill exhibited a specimen of a large hydatid cyst removed from a child from Shetland aged 4 years.

Hogarth reported a case of an hydatid cyst of the liver in a girl aged 12. Daughter cysts obtained.

Marsupialization was the treatment adopted and ultimate recovery occurred though bile escaped for a long time.

Cameron's case was that of a girl aged 10 from Shetland (where the disease is fairly common) with a large suppurating abdominal cyst. Most of the fat was resected and the rest marsupialized.

Walker (South Africa) published the case of an hydatid cyst of the floor of the mouth in a Kafir female aged 6. It was excised with a part of the submaxillary gland. The cyst contained scolices hooklets and daughter cysts. Rapid recovery.

Buckley totally enucleated two hydatid cysts from the liver of a girl aged 13. Recovery resulted. Posadas practiced a similar procedure in 20 cases in patients under the age of 13. The youngest aged 3.

Cornier quoted the case of a pedunculated hydatid cyst of the liver in a girl aged 3. Resection recovery. He remarked that in inflamed liver tissue the stitches hold better than in normal liver tissue.

Lapage operated upon an hydatid cyst of the brain in a boy aged 10. The boy died in 3 weeks from hernia cerebri and meningitis. There was no postmortem. The pathological report was hydatid cyst.

Gaiger (South Africa) reported the case of an hydatid cyst of the brain in a boy aged 6 in whom enlargement of the head had been noted for years. At postmortem a large cyst was found containing 8 ounces of clear fluid distending the right lateral ventricle. No hooklets but typical laminated cyst wall was found.

Hughes described the case of an hydatid cyst of the liver in a boy aged 12. Operation daughter cysts marsupialization and drainage. Hooklets removed. The cavity was irrigated with for malin for several weeks when it healed soundly.

Sargent published the case of an hydatid cyst of the brain in a child aged 12. At operation a large hydatid cyst was removed. It reached the surface just behind the left fissure of Rolando. The diameter of the cyst was 6 centimeters and it contained 60 cubic centimeters of fluid. Had postoperative convulsions but showed rapid general improvement.

Jewesbury reported hydatid cysts of the pleura and lung in a boy aged 8. Diagnosis empyema. The left chest was tapped. Clear fluid with scolices being evacuated. The complement fixation test was positive. Eosinophils 6 per cent. The X-ray demonstrated an hydatid cyst. The boy had always lived in England and had never had intimate relationship with dogs.

Neve (India) described the case of a Mohammedan boy aged 12 with hydatid cysts in both lobes of the liver. Hooklets were demonstrated. Both cysts were treated by marsupialization and drainage. Recovery. Almost complete destruction of the liver obtained.

Germany Wohlgenuth reported a case of multiple hydatid cysts of the liver in a girl aged 15. Operation formoage and marsupialization. He notes that in cases of multiple hydatid cysts of the liver

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the difficulty experienced in delivering this organ through the perineum for resection it is probable that such a catastrophe would be accompanied by pain comparable to that experienced in delivering the fetal head and it is not recorded that sudden prolapse causes such agony. It is also true that extensive perineal lacerations are sometimes followed by prolapse of the rectum but they are even more frequently followed by prolapse of the uterus and we believe that few gynecologists hold that such lacerations alone produce this condition.

Numerous exciting causes may obviously be added such as constipation prolonged sitting at stool faulty position at stool prolonged diarrhoea with tenesmus heavy lifting and stricture of the rectum or the urethra but all are so common that it is impossible to assign to them more than a minor part in the production of rectal prolapse. It is probable that polypoid tumors and high strictures may lead to the formation of sigmoidorectal intussusception and that this condition may in turn be converted gradually into a first or second degree rectal prolapse but such cases are very infrequent.

Whatever be the cause of the condition however we have in the end to deal with an anatomical defect as in hernia and any method of treatment must be directed toward correction of the more or less mechanical deficiency. We are not of course considering such small protrusions as may be cured by non operative measures.

#### THE OPERATIVE PROCEDURES IN USE

Innumerable operations have been devised for the cure of rectal prolapse none of which has proved entirely satisfactory. To mention them briefly they include

1. Excision of the offending organ either totally or in part (Mikulicz Cunningham). This method seems to have fallen gradually into disfavor. It is an illogical procedure at best since none of the supports are restored and since further prolapse is inhibited only by the meso sigmoid. The normal motor mechanism of the rectal pouch is of course entirely destroyed wound infection gangrene of the gut and peritonitis are not uncommon se-

quelae and recurrence is estimated to be as high as 54 per cent so that the technique on the face of it has little to commend it.

2. Suspension of the bowel within the abdomen with or without obliteration of the cul de sac (Moschowitz). This method also has few advocates which is not surprising in view of the decidedly indifferent results obtained by a similar technique in suspension of the uterus or the stomach. It must be pointed out however that the simultaneous obliteration of the cul de sac and the suspension of the rectum by pursestring sutures beginning at the depths of the pouch has much to recommend it. As advocated by Quenu and Moschowitz it has the virtue of restoring the anterior fixation of the lower rectum and preventing the direct action of intra abdominal pressure on the abnormally mobile bowel. Moschowitz adds that relaxation of the sphincter ani and prolapse of the mucous membrane may require additional treatment. This operation is plainly based on the theory that an abnormally deep cul de sac is the primary cause of the prolapse which begins as a hernia of the anterior wall of the rectum through the anus. In our opinion this theory accounts for some instances of this condition and possibly for all of them and this being the case the method is a sound one but it is open to serious practical objections. In the first place it is a severe and difficult operation not suited to debilitated or aged patients and in the second place while it is a reasonably simple procedure in women it is a very difficult one in men and necessitates suture of the rectum to the bladder a dangerous and illogical performance.

3. Fixation of the rectum to the sacrum and coccyx (Tuttle Sick Mummery). This procedure usually combined with shortening of the external sphincter is rather generally favored. Tuttle's method of scarification and suture seems rather the more popular technique but Mummery reports great success with a modification of Sick's method. This consists in dissecting the organ free from the sacrum and packing the space until it is obliterated by granulation tissue. The result is a firm scar which re-establishes one of the normal supports. These methods however

AN OPERATION FOR COMPLETE PROLAPSE OF THE RECTUM<sup>1</sup>

BY URBAN MAES M.D. F.A.C.S. AND JAMES D. RIVES M.D. NEW ORLEANS, LOUISIANA

**P**ROLAPSE of the rectum is usually defined as being any protrusion of the entire circumference of the rectum through the anus while complete prolapse is defined as being such a condition involving all the coats of the bowel. This definition is sufficient for all practical purposes although it does not include what seems to be described invariably as third degree prolapse. Three degrees are differentiated: (1) cases in which the mucous membrane of the anus descends with the prolapse; (2) cases in which the anal canal is not involved; (3) cases in which the inversion begins at or somewhere near the recto sigmoid junction and does not protrude from the anus. Manifestly this last group is not included in our original definition and rightly so since it should be classed as sigmoidorectal intussusception rather than as rectal prolapse. Furthermore the first and second groups would be more accurately described as types rather than as degrees of prolapse since the distinction between them is in kind rather than in degree.

This discussion is limited to complete prolapse of the rectum in adults and more specifically in males since all cases treated by us according to this technique have been in men.

The etiology of rectal procidentia is somewhat obscure. Normally the rectum is held in position by 3 types of supports. Passive supports the first type include the peritoneal folds reflected from the rectal walls onto the bladder or vagina and the hollow of the sacrum the direct fibrous attachments to the prostate or vagina the sacrum and the coccyx and the lateral ligaments of the rectum which are attached to the pelvic fascia covering the levatores ani. To these may be added the vessels and nerves which supply it although it seems improbable that these play much part since it has been shown that the vessels are so tortuous that if they were straightened without tension they would permit moderate degrees of prolapse (Todd).

The second group includes the so called active supports the levatores and the sphincter ani while the third type of support is by conformation and position. The sharp backward angulation of the rectal tube from the prostate (or vagina) to the outlet tends to throw the weight of the pelvic viscera onto the bladder (or uterus) in front and pressure applied vertically closes the anal canal provided the rectum be normally empty. This condition saves strain on the other supports of the rectum, just as normal ante flexion of the uterus spares its fibrous and muscular supports.

Prolapse of the rectum obviously cannot occur so long as its active and passive supports are intact. Either they must be weakened by constitutional conditions such as wasting diseases or old age or by prolonged strain or they must be congenitally defective. It is significant we think, that although wasting diseases old age and prolonged strain are relatively common conditions procidentia of the rectum is quite infrequent and we are therefore inclined to believe that while they doubtless play some part a congenital defect is usually if not always present.

This defect may take the form of an unusually long mesorectum or mesosigmoid, we are not impressed by the effectiveness of peritoneum as a ligament. It may be faulty fascial development a condition known to be definitely present in certain cases as in our first. It may be an abnormally deep cul de sac as suggested by Quenu and Moschowitz a condition which prevents the backward angulation of the rectum at the level of the prostate since the bowel is not fixed to the prostatic capsule at all and intra abdominal pressure is applied directly to the anal orifice stretching it instead of closing it as should be the case. Again the anterior rectal wall may be pushed like an obturator through the anus.

It is of course possible that great strain suddenly applied might rupture the structural supports of the rectum but in view of

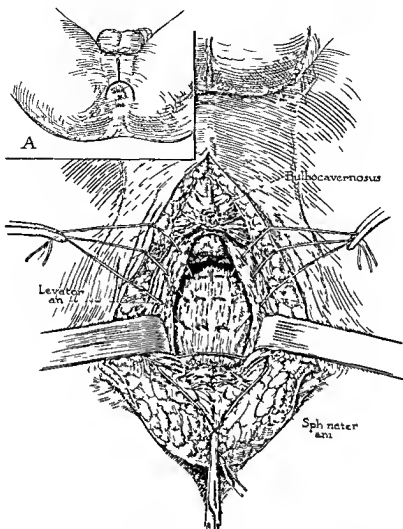


Fig 1 The anatomy of the operative field and the method of applying the sutures

pects of the rectal walls. From this point the needle is carried up to a point on the left levator corresponding to the first bite on the right and a similar stitch is taken here. Three or 4 sutures of the same type are inserted at short intervals until the free margins of the levatores are reached. Each of these sutures when tied approximates the levatores and suspends and plicates the rectum and closes the depth of the cul de sac. A last suture approximates the free margins of the levatores but does not pick up the rectum. This permits the anus to be thrown backward re-

producing the normal backward angulation of the anal canal. The effectiveness of this feature is illustrated in Case 2 in which although the sphincter was absent a fair degree of control of solid feces was obtained.

When relaxation of the pelvic floor is extreme it may be necessary to supplement this procedure by fixing the posterior wall of the rectum according to the method of Tuttle. Mucous membrane prolapse may mar an otherwise perfect result as in our third case but this may be easily corrected by linear cauterization or excision.



provide support only posteriorly and do not restore either the pelvic floor or the support of conformation so that the forces which aided in producing the original prolapse are permitted to act unchecked. Furthermore a practical objection to Mummery's modification is that the patient must remain in bed 4 weeks and that for 2 months defecation must take place in the recumbent position.

4 Plication wedge shaped excision excision of the mucous membrane and similar methods designed to shorten or narrow the gut (Difffenbach Roberts Delorme Duret etc.) These methods are all obviously of value only in simple cases. In particular resection of the mucous membrane with plication of the other coats has little or no support among English and American surgeons.

5 Plastic restoration of the pelvic supports usually limited to narrowing the external sphincter (Duval Ienormant Lynch etc.) Excision of wedges of the lower rectum are sometimes included in this technique also. The method is effective in mild cases and forms according to Mummery an essential part of any operation for rectal prolapse.

We have found it difficult indeed impossible to form an accurate impression of the relative merits of these various procedures. Few of the authors give statistics of their results and though each seems fairly well satisfied with his own technique the multiplicity of operations and modifications makes it plain that the methods in use still leave much to be desired.

We have developed a plastic operation on the levatores ani and pelvic fascia which is based on the assumption that an abnormally deep cul de sac together with relaxation of the lateral ligaments the levatores ani and the sphincter ani is the cause of complete prolapse of the rectum. The method grew out of the idea that relaxed levatores might easily be corrected by the vaginal route and that at the same time a deep cul de sac might be obliterated and the rectum suspended as in operations for high and extensive rectocele according to the technique advocated by George Gray Ward and others.

It should be noted that since we began our work in 1922 Lynch has reported a method

of plication of the lateral ligaments in front of the rectum which is quite similar in principle to the one devised by us though applicable only to women. We might say too that while the operation is original with us we have recently learned that a very similar procedure was reported by Duval and Lenormant in 1904. They reported 3 successful cases at that time but we have been unable to find a subsequent report by them and no one else seems to have tried the method. Bickham is the only authority consulted who even mentions it and he gives no bibliographical reference.

#### DETAILS OF THE AUTHORS PROCEDURE

With the patient in the lithotomy position the prolapse is reduced and an inverted Y incision is made with the arm embracing the anus. This is deepened to expose the external sphincter. The anobulbar raphe is cut across thus freeing the sphincter from the central tendon of the penneum. The anterior quadrant of the external sphincter is now excised and the muscle immediately sutured end to end with U sutures of chromicized gut. The incision is deepened to expose the levator ani. Its medial margins are separated by blunt dissection with scissors. With a finger or a pack in the rectum as a guide the anterior and lateral walls of the rectum as far as the lateral ligaments are exposed. This is best done by blunt dissection with a gauze covered finger. The prostate and seminal vesicles are pushed forward. If the cul de sac is abnormally deep the reflection of peritoneum from rectum to prostate will now be encountered and should be carefully pushed up until the prostate is exposed in front and the adventitia of the rectum as far as the finger will reach behind. The superior surface of the levator ani covered by the pelvic fascia now forms the lateral wall of the space. Beginning at the apex of this artificial vagina sutures are introduced to approximate the levatores and suspend the rectum. Chromicized catgut on full curved round needles is used. A deep bite is taken in the levator and fascia on the right the needle is then carried down an inch or an inch and a half and several transverse stitches are taken across the lateral and anterior as

He was readmitted for examination 6 months afterward. A slight eversion of mucous membrane was present not more than a quarter of an inch but there was no evidence of prolapse and the spluncer control was normal. In May of this year he was examined at the office at which time there was a mucous prolapse of about an inch which was quite oedematous. The rectal wall was firmly fixed. November 19 1925 he returned complaining of a recurrence of the original condition. Careful examination showed that the posterior semicircle of the rectum had prolapsed about an inch (not nearly so much as originally) and that the anterior portion was so firmly fixed in position that the gauze covered finger could not produce eversion of even the mucous membrane. Posterior fixation will be done later and we believe should be done in every case no matter what the type of prolapse.

In addition to these cases we are able to add one more a woman through the courtesy of Dr J deJ Pemberton of the Mayo Clinic. The operation was done at the suggestion of one of us (Maes) and the report 5 months after operation is that the results are perfect. Posterior fixation was done in this instance.

It will be readily seen that this operation has evolved gradually and that the results have not been ideal. We believe however

that we have discovered and corrected its weaknesses and that as it stands today it offers a satisfactory technique for all cases of rectal prolapse in which complications do not exist and in which the condition is not extreme.

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We might add that the operation is not difficult that it produces practically no shock and that it is quite practicable with spinal or local anesthesia.

The number of our cases 3 is of course too small to permit of conclusions. We have delayed this report in the hope of adding to their number but without success and we therefore present it now in the hope that others may try the method and demonstrate its merits or its faults.

#### CASE REPORTS

**CASE 1.** F. F. white aged 60 grocer was admitted August 29, 1932 complaining of piles, rupture and sore on thigh. The past history was irrelevant except for osteomyelitis of the lower third of the right femur 20 years ago which had never healed. Left inguinal scrotal hernia had been present for 8 years, piles for 2 years. Physical examination revealed an obese man looking much older than the 60 years he claimed as his age. He appeared quite sick and very feeble. A systolic murmur at the apex of the heart and moderate enlargement were noted. Edema of the feet and dyspnea seemed to indicate failing compensation. There was a large reducible scrotal hernia on the left. The rectum protruded 3 or 4 inches and was quite red and edematous. The mucous membrane was gangrenous at the center. Urinalysis showed many casts but no albumin. Other laboratory examinations were negative.

Elevation of the hips and hot moist applications led to subsidence of the edema and separation of the sloughs of mucous membrane. After a week of this treatment the prolapse could be reduced but would not remain so even with the hips elevated. The external sphincter was completely relaxed and the perineum was convex downward instead of concave a condition which suggested the idea of reinforcing the relaxed levatores.

Three months later when the patient had gained sufficient strength to permit of surgical intervention under spinal anesthesia the operation described above was performed except that the rectum was not included in the sutures.

Convalescence was uneventful but the patient's general condition was so poor that he was kept in the hospital until February 24, 1933. He was then discharged with instructions to return at intervals for examination; he failed to do this and we have been unable to trace him.

At the time of his discharge a slight mucous membrane prolapse persisted but this first attempt was fairly satisfactory in spite of our failure to suspend the rectum. It was however an incomplete operation and in view of the extreme muscular relaxation of the perineum we strongly suspect that the posterior half of the rectum did not remain in position.

**CASE 2.** C. D. colored male aged 29 laborer was admitted September 6, 1933 complaining of incontinence of feces and protrusion of rectum. The past history was mainly irrelevant except that the right leg had been amputated because of an injury with infection the previous year. There was no history of constipation. The present illness began 5 years ago with protrusion of the lower bowel during defecation. The first operation was performed the following day which suggests that the prolapse must have been quite extensive as negroes do not ordinarily seek hospital treatment for minor ailments. Within 5 years he had had 3 operations for this condition each time being hospitalized from 2 to 15 months. Two of these operations were said to have been for hemorrhoids, the third was definitely a rectal affair but he knew nothing of the detail. Incontinence developed after the second operation and the condition had grown steadily worse.

Physical examination revealed the rectum protruding about 3 inches and easily reducible. The anus gaped widely and there was no evidence of sphincter action voluntary or reflex. An irregular scar particularly dense in front surrounded the anus.

Operation was performed September 13, 1933 under ether anesthesia. The procedure described was performed without incident except that the density of the scar anteriorly made exposure of the lower margins of the levatores quite difficult. No trace of the external sphincter could be found.

Convalescence was uneventful except for a slight skin infection at the anal margin. The patient was allowed up on the fifteenth day and discharged fit for duty on the thirty-third day. At the time of discharge there was not the slightest tendency to prolapse even on straining. Sphincter action was entirely absent but the patient was able to tell when the bowels were ready to move in sufficient time to reach a toilet. If the stool was solid an effort was required to evacuate the rectum. No follow up was obtainable.

**CASE 3.** G. W. white male aged 42 clerk was admitted May 7, 1934 complaining of piles. The previous history was negative. Piles for 5 years relieved by operation. In March of this year while on a drinking party he suddenly developed a painful protrusion of the rectum which was gradually reducible but would recur at stool and after any exertion. It had grown progressively worse and at the present time was reducible only in the recumbent posture. There was constant soiling of the clothing.

Physical examination revealed nothing except a first degree prolapse of the rectum of about 2 inches and a relaxed sphincter.

Operation as described was performed May 12, 1934. Convalescence was uneventful except that after the second day the patient could not be kept in bed and sat up in a chair most of the time. In spite of this the prolapse was entirely corrected when he was discharged on the fourteenth day after operation. Further hospitalization seemed useless as he persisted in defying orders.

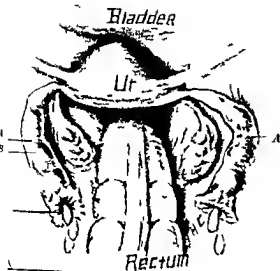


Fig. 1. Showing an initial gonorrhoeal salpingitis. *A* Inflamed tubes *B* ovaries *C* fimbriated end from which purulent material is exuding

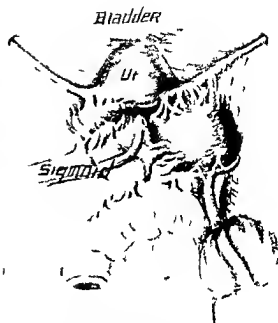


Fig. 2. Illustrating complicated lesions following recurrent attacks of pelvic inflammation

the lowest 4 000 and the highest 7 000 12 hours later. The other 21 patients showed either no increase or a slight reduction in the existing leucocytosis.

In no case treated with this preparation was there any relief of pain, reduction of the pelvic inflammation or diminution of the vaginal discharge.

Foreign protein in the form of normal horse serum was administered to another group of 15 patients with similar pathology. This serum was injected subcutaneously in 40 cubic centimeter doses after a previous cutaneous test had been made to ascertain the susceptibility to anaphylaxis. A marked general reaction followed in 50 per cent of these patients with rise of temperature and the typical skin eruption of serum sickness. When the reaction subsided these patients showed a beginning resolution of the pelvic infection, reduction of pain and tenderness, a decrease and in some cases complete cessation of the vaginal discharge. Because of severe reactions in 2 cases as manifested by extreme illness from the injections and because of no improvement in the pelvic infection unless a reaction was obtained the use of this therapy was discon-

tinued. The risk involved and the lack of uniform results from its employment did not warrant its continued use.

Diathermy as a therapeutic agent has yielded definite results when applied to pelvic infections of gonorrhoeal origin. The penetration of the pelvic structures by an electrical high frequency current through properly placed electrodes generates heat in the tissues to varying degrees. The intensity of the heat can be controlled by the size of the electrodes and the amount of current utilized, measured in milliamperes. It is an established fact that the gonococcus is susceptible to comparatively low degrees of heat. An exposure to 42 degrees C for 10 minutes will destroy it completely. By the use of diathermy a temperature of 45 degrees C can be generated in pelvic structures without discomfort to the patient or damage to the tissues. Destruction of the gonococcus is thereby assured. By means of experimental work upon rats and dogs I have demonstrated that skin, subcutaneous tissue, bone and the internal pelvic

## THE TREATMENT OF PELVIC INFECTIONS

WITH AN ANALYSIS OF 1105 CASES

BY THOMAS H. CHERRY, M.D., F.A.C.S., NEW YORK CITY

**D**URING the past 8 years 40 per cent of the patients admitted to the Gynecological Division of Harlem Hospital, New York City, have had some variety of adnexal infection. There were 1105 cases of adnexal disease, and these form the basis for the clinical study herein submitted.

It is not the purpose of this paper to offer anything new in the way of conservative or surgical treatment, but solely to analyze and record the treatment and clinical end results.

These cases can be divided into the gonorrheal and non gonorrheal. In this series of cases of adnexal disease approximately 88 per cent are regarded as gonorrheal in origin, 12 per cent non gonorrheal. In the latter group the condition was due to infections following birth trauma, secondary infections associated with other pelvic pathological changes and in a small number, to tuberculosis.

Attempts to classify these groups more accurately by prevailing laboratory methods were unsuccessful. In the presence of urethral and cervical discharges only 12 per cent of smears demonstrated the gonococcus. Cultural methods also proved disappointing. Complement fixation tests from the blood were not only valueless but in some instances were even misleading. Intradermal injections of specific bacterial proteins were tested and seemed devoid of diagnostic significance (3).

As the gonococcus has a predilection for mucous membrane and the site of the primary infections is the urethra or cervix, one can classify adnexal disease as gonorrheal (1) when smears from the urethra or cervix show the presence of gram negative intracellular diplococci, (2) when in spite of negative smears there is observed an endocervicitis with a urethritis, skenitis or Bartholinitis, and (3) when there is adnexal infection with infections of the above anatomical sites the smears from which show a preponderance of pus cells.

While these clinical observations are not scientifically accurate criteria for the diagnosis of the etiological factors in genital tract infections, they may be relied upon until more improved biochemical methods have been devised.

Patients having adnexal disease sought admission to the hospital for relief of abdominal pelvic pain. They were usually seen in the acute stage of pelvic inflammation, whether suffering from an initial attack or an exacerbation of a chronic condition. Examination of these patients disclosed the presence of a vaginal discharge either from a concomitant urethritis or endocervical infection. The adnexa were tender and enlarged. The temperature varied from 100 to 104 degrees F.

During this period conservative measures only were applied. Sedatives were given to ameliorate pain, ice bags were applied to the abdomen and hot vaginal douches prescribed to aid nature in the control of the infection. Local treatments were given for the urethritis and endocervicitis. In the event of a suburethral or Bartholin abscess the pus was evacuated by incision and drainage.

Certain groups of these patients were selected at different times to test various forms of the newer therapeutic measures such as intramuscular injections of milk preparation, normal horse serum, and medical diathermy.

The principles upon which the theory of non specific foreign protein therapy is based will not be discussed. A group of 25 patients having acute adnexal infections with readily demonstrable pelvic lesions were given a sterile lactalbumin preparation (Aolin). This was administered by intramuscular injections in 10 cubic centimeter doses as recommended by Heinemann (6). The subsequent temperature, leucocyte counts and clinical symptoms were carefully observed. No general reaction followed in any instance. The leucocyte count showed an increase in 4 patients.

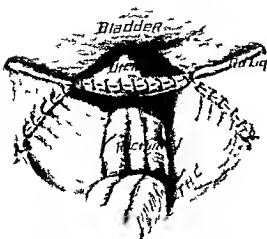


Fig 5 Round ligaments have been implanted and broad ligaments and fundus uteri sutured

applications as well as by the use of the Corbus thermophore in the urethra. Abdominal operations were performed upon 832 patients whose history or physical findings indicated recurrent adnexal inflammation. Fifty-four patients who had concomitant pelvic abscesses with tubal infection were drained through the vagina. 3 deaths occurred a mortality of 5.5 per cent.

In the entire series of 887 operative cases there were 44 deaths a mortality of 4.6 per cent.

When patients with an initial attack of acute salpingitis were admitted they were treated by the conservative measures already outlined. Resolution as a rule occurred and in some instances the tubal lumen apparently became re-established. This was particularly true if it was possible to free the lower genital tract of infection. A few cases of this type were operated upon in the presence of pronounced right-sided pain; they were mistaken for cases of appendicitis. Under such circumstances the adnexa were not disturbed and the abdomen was closed.

During an exacerbation of a recurrent chronic infection surgical interference was performed only when there was evidence that the infection was spreading beyond the pelvis and producing a generalized peritonitis. Spontaneous rupture of a pyosalpinx or tubo-ovarian abscess occurs infrequently, but when



Fig 6 Giant pyosalpinx of left side adherent to hilum of spleen. Tubo-ovarian abscess present in right side

such an accident does occur generalized peritonitis develops and operative interference should not be delayed.

When a pelvic abscess forms drainage by the vaginal route is established and laparotomy is deferred until a later date.

The abdomen was opened in the presence of acute symptoms 81 times. When there was definite evidence that a chronic infection was present the pathological masses were removed if feasible otherwise proper drainage only was established.

The chronic cases of adnexal infection presented interesting variations in pathology. Some showed slightly thickened tubes the fimbriated ends of which were or were not occluded; adhesions were few in some instances in others dense. Some tubes were greatly thickened and fibrosed and densely adherent to surrounding pelvic structures most contained a purulent exudate of varying consistency that as a rule proved sterile. The tubes were often much enlarged containing thick creamy pus communications between the pyosalpinx and ovary forming tubo-ovarian

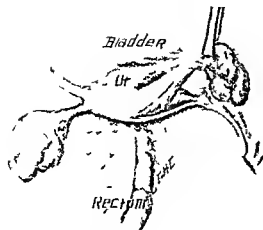


Fig. 3 First step in a fundal hysterectomy with removal of both adnexa

organs will withstand a temperature of 50 degrees C without morphological changes.

In a previous article (1) a report was made of 52 patients with adnexal disease to whom diathermy had been applied. The treatments were administered by means of vaginal or rectal electrodes with an inactive electrode upon the abdomen or sacral region. In some instances a sacro abdominal application was made. The number of milliamperes used varied from 7000 to 3000 but in all cases sufficient current was utilized to raise the vaginal temperature to 43 or 45 degrees C for 25 to 35 minutes.

Gratifying results followed the immediate cessation of pain being particularly impressive. In 36 patients whose pelvic lesions consisted of tender and painful masses there was complete resolution of the masses in 12 and a marked reduction in size in another 11.

In 12 additional patients however the masses were apparently unaffected and not reduced in size although there was a decrease in body temperature and relief of abdominal pain. It is interesting to note that when 8 of these patients were operated upon large pus tubes or tubo ovarian abscesses were removed more easily than usual adhesions seemed softer more hyperemic and were easily separated by blunt dissection, the masses themselves appeared softer, were cedematous and readily delivered without rupture. The inflammatory

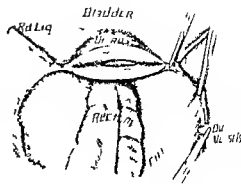


Fig. 4 Drawing showing pelvic structures and fundus of uterus removed

products consisted of a thin watery straw colored material instead of the thick creamy purulent material usually encountered. All cultures from these masses were sterile. Convalescence in these cases was remarkably smooth all wounds healing by primary union.

In postpartum and postabortion adnexal infections the application of diathermy was not as successful as in those of gonorrheal origin. The pain was only temporarily relieved and then recurred. In one case of a fresh postabortion infection a generalized peritonitis was aggravated and death followed. Another patient having a postpartum infection of the adnexa to whom diathermy was given showed a spreading pelvic peritonitis with abscess formation necessitating evacuation and drainage.

The bacteria most active in postpartum infections are the streptococcus, staphylococcus and colon bacillus. To destroy these microorganisms 58 to 60 degrees C of heat are essential but since such temperature coagulates tissue the use of diathermy is precluded in most cases of this type of pelvic infection.

Two hundred and eighteen patients having adnexal disease were treated conservatively and not operated upon. After the acute symptoms had subsided the endocervicitis was treated to prevent a reinfection of the canal. This consisted of cauterization of the canal in some cases electro coagulation in some and the application of dyes in others. The urethra and Skene's ducts were treated by topical

active infective process and that one of 60 minutes or less suggests a latent infection. Friedlander (5) prefers not to operate upon pelvic infections until the sedimentation time is well above 60 minutes. In a previous article (2) the writer presented a comparison of the relative value of the leucocyte count and sedimentation time of the erythrocytes in a group of 71 patients operated upon for adnexal disease. Twenty nine patients of this group showed a sedimentation time of less than 30 minutes but their average leucocyte count was 13,250. There was no mortality and the morbidity averaged 18.2 days. Twenty six patients showed a sedimentation time of between 30 and 60 minutes with an average leucocyte count of 10,200. There were no deaths and the morbidity averaged 16 days. The rest of the group 16 patients had a sedimentation time above 60 minutes with an average leucocyte count of 10,000. One death occurred in this group from a general peritonitis with the sedimentation time of 68 minutes.

From these comparative results as well as from other isolated instances one cannot help but believe that in estimating the activity of an infective process greater reliance should be placed upon the white cell count than upon the sedimentation of the red cells.

At operation I first dispose of the endocervicitis either by performing a trachelo-plastic operation or by thoroughly cauterizing the endocervical mucosa. The abdomen is then opened and the tubo ovarian masses removed. No attempt is made to salvage portions of damaged ovaries or tubes. In previous years such attempts at conservation were frequently made with disappointing results. In 10 such instances it was necessary to evacuate secondary abscess formations by colpotomy.

In patients with extensively involved adnexa a fundal or supravaginal hysterectomy was done in order to extirpate all infective foci. This operative maneuver was performed 159 times. When ovaries appeared normal they were suspended to the fundus uteri by shortening the utero ovarian ligament. The ovaries were conserved in 401 cases.

In many instances upon removal of both tubes with retention of one or both ovaries

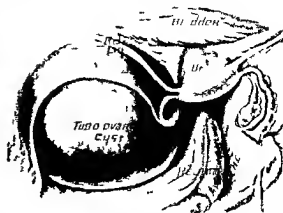


Fig. 9. Large tubo-ovarian cyst simulating intraligamentous mass.

the uterus was suspended either by a fixation suture or shortening of the round ligaments. This was done to prevent a postoperative retrodisplacement which will otherwise occur in 70 per cent of cases.

In the separation of adhesions care was taken to prevent injury to the intestinal walls. The judicious use of sharp dissection where blunt separation seemed harmful prevented many such injuries. In some instances portions of the inflammatory masses were cut away and allowed to remain attached to the gut wall rather than risk perforation. In spite of this extreme care in technique accidental intestinal opening occurred 12 times, 5 times in the sigmoid and 7 times in the small intestines. Resection was necessary in 1 case otherwise single suture sufficed. No deaths occurred from injury to the large gut but 4 patients died from the injuries to the small gut a mortality of 33 1/3 per cent.

Among the 833 abdominal sections for adnexal disease pus was encountered and the peritoneal cavity was soiled 324 times. When such an accident happens the question of whether or not to institute drainage is naturally foremost in the mind of the surgeon. To determine which pus cases require drainage many things must be taken into consideration. Practically speaking all these adnexal infections originated as gonorrhoeal inflammation. The chronicity and subsequent acute



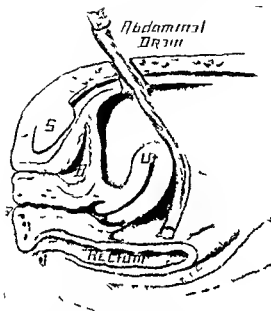


Fig 7 Cigarette drain inserted through lower angle of abdominal wound down to cul de sac

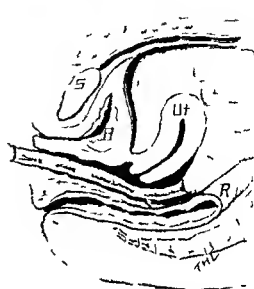


Fig 8 Cigarette drain through vaginal vault into cul de sac

abscesses or cysts were not uncommon. Infective processes may take place in the ovaries presenting a simple ovaritis, retention cysts or abscesses.

In this same group there were 806 patients operated upon for tubo ovarian abscess or cyst, 144 cases pyosalpinx, 386 and thickened adnexa with peritubo ovarian adhesions, 276. Incidental pathological changes noted were cystic ovary in 118, ovarian cyst in 61, tubal pregnancy in 8, hydrosalpinx in 16, intraligamentous cyst in 1, papillary cyst adenoma of the ovary in 1, ovarian cyst adenocarcinoma in 1, fibromyoma in 85, appendicitis in 83, retrodisplacements of the uterus in 102.

These patients presented clinical evidence of a recurrence of pelvic infection, either acute or subacute. Abdomino pelvic pain was a pronounced symptom; temperature ranged from 100 to 104 degrees F, leucocyte counts varied from 8,000 to 30,000 depending upon the severity of the infection and the patient's resistance. Practically all had an endocervicitis with a mucopurulent vaginal discharge. Many had urethritis, skenitis and Bartholinitis.

During the acute stage conservative therapeutic measures were instituted until it subsided as shown by normal temperature, pulse rate, lowering of leucocyte count and amelioration of pain.

Early operation has been adopted as a wise policy by the personnel of the Gynecological Department of Harlem Hospital following subsidence of the acute exacerbation. It has been considered safe to operate when the patient's temperature has been normal from 3 to 10 days and the leucocyte count is below 16,000.

In 508 patients operated upon whose recorded leucocytosis was below 16,000 there were 21 deaths or 4.1 per cent mortality. Among 120 patients with a leucocytosis above 16,000 there were 20 deaths or 16.6 per cent mortality. These observations demonstrated the value of the leucocyte count as an indicator of the reaction or acquired immunity of the patient to the pelvic infection.

European Clinics place great dependence upon the sedimentation time of the red blood cells as a more reliable indicator of the activity of infection.

Linzenmeier (8) believes that a sedimentation time of below 30 minutes indicates an

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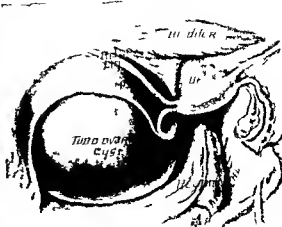


Fig. 9. Large tubo-ovarian cyst simulating intraligamentous mass.

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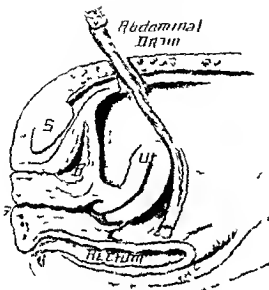


Fig. 7 Cigarette drain inserted through lower angle of abdominal wound down to cul de sac

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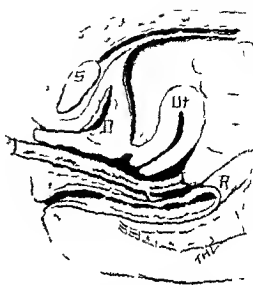


Fig. 8 Cigarette drain through vaginal vault into cul de sac

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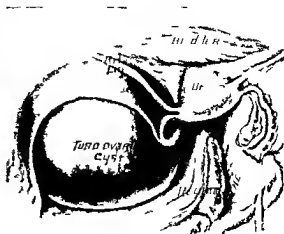


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exacerbations were due either to a fresh infection of another gonococcal strain or a recrudescence of the original one. Occasionally the acute exacerbations were due to the invasion of the field by other pyogenic bacteria which also may persist as a low grade inflammatory process producing great damage to the pelvic organs, however in the course of time the resistance of the tissues overcomes these invading germs and an immunity is established. The pus in most instances becomes free of bacteria. It is true that the tissues of the tubal wall may harbor these bacteria, as shown by Curtis (4) in tissue cultures but an immunity to this has also been attained and they are usually quiescent and not virulent.

The introduction of a drain into the peritoneal cavity either through the abdominal wound or vaginal vault produces a peritoneal irritation that according to Hertzler (7) surrounds it with adhesions sufficient to exclude it from the peritoneal cavity. At the end of 48 hours these adhesions are fairly firm and the drain has accomplished its purpose in establishing a communication for the escape of infective material therefore on the third post-operative day the drain should be gradually withdrawn and shortened and by the seventh day it should be entirely removed. Instances occur when the advisability of establishing drainage is questionable. The old slogan

When in doubt drain might be paraphrased to read When in doubt drain but don't drain long. Under these conditions the drain should be removed by the fourth or fifth day. When infection has not taken place the communicating sinus will close more quickly.

In my opinion it is not necessary to drain the pelvis in pus cases when a smear shows the absence of bacteria when the temperature has remained normal for a period of from 3 to 10 days and the leucocyte count is below 16,000.

A guide to the infectivity of pus in the 34 contaminated cases is well illustrated by the mortality of 4 per cent in those patients whose leucocyte count was under 16,000 while a mortality of 20 per cent occurred in those patients whose leucocyte count was above 16,000.

The most logical site for the establishment of drainage in pelvic surgery seems to be through the vaginal vault rather than through the abdominal wound. Occasions frequently arise however that necessitate for the sake of speed the latter course. Drains were also inserted for hemostasis when persistently oozing areas could not be controlled otherwise. Drainage was established 163 times 126 times in the presence of pus contamination and 37 times for bloody oozing.

It is interesting to note that in the contaminated series when no drainage was used the mortality rate was 3.8 per cent and primary union occurred in 79.6 per cent of the cases. When abdominal drainage was instituted the mortality was 14.3 per cent with primary union in 18.3 per cent of the cases. When vaginal drains were inserted the mortality was 10.2 per cent and primary union occurred in 63.2 per cent of cases.

In the entire series of 578 cases in which drainage was not employed 18 patients died a mortality of 3.1 per cent, of 125 patients with abdominal drainage 19 died a mortality of 15.2 per cent, of 38 patients with vaginal drainage 4 died a mortality of 10.5 per cent.

It would seem from these statistics that when pus is encountered in pelvic infections no drainage yields the best results and when the operator decides that drainage is necessary the vaginal route is better than the abdominal.

#### CONCLUSIONS

1. In 1105 cases of pelvic infections in the Harlem Hospital New York City the gonococcus is the inciting agent in 88 per cent and in 12 per cent the condition is due to other causes.

2. Exclusively conservative treatment of adnexal disease is on the whole unsatisfactory. The patient upon discharge from the hospital is inclined to ignore the advice given urging return visits and reinfection of the adnexa often occurs.

3. Injections of foreign protein in the form of milk preparations (Aolan) and horse serum have proved unsatisfactory.

4. The use of diathermy as a conservative measure in the treatment of adnexal disease of gonorrheal origin was the most successful of

the palliative methods as it caused a resolution of pelvic masses in 66.6 per cent of patients besides relieving pain in practically 100 per cent. It also by proper application of electrodes controlled the infection of the lower genital tract.

5 Initial acute attacks of adnexal inflammation should not be treated surgically as they spontaneously subside. Re-infection should not occur if the lower genital tract is properly treated.

6 Recurrent attacks of pelvic inflammation are excellent reasons for the surgical removal of the pelvic lesions. Such surgical procedures can be performed with a reasonable assurance of not more than a 3 per cent operative mortality if the temperature has remained normal for 3 to 10 days and the leucocyte count is below 16,000.

7 When in the course of operative removal of infected adnexa pus contaminates the per-

itoneal cavity the best results as to mortality and wound union are obtained by closure of the abdomen without drainage. If drainage is necessary the vaginal route is better than the abdominal.

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RESULTS OF HYPOGLOSSOFACIAL ANASTOMOSIS FOR FACIAL PARALYSIS IN TWO CASES<sup>1</sup>

BY ALFRED BROWN, M.D. OMAHA, NEBRASKA

THE operation of anastomosis between hypoglossal and facial nerves for the relief of facial paralysis was first performed by Koerte (5) in 1901 and described by him in 1903. Since that time reports have appeared sporadically in the literature but the operation does not seem to have received the attention that its results would merit. From the standpoint of physiology the procedure appears to be the one that would offer the best results, as aside from the restoration of nerve continuity the question of restoration of psychic control must be considered. Fra-

zier and Spiller (2) divide the desiderata in facial nerve recovery into three main classes: First the restoration of normal contour to the face during rest; second the restoration of voluntary motion in the muscles; and the third the restoration of emotional expression. The third division is the result mostly to be sought for and because of the close relation between the cortical centers of the hypoglossal and facial nerves as illustrated by Gibson (3) an anastomosis between facial and hypoglossal nerves would seem to offer the best therapeutic results. (See Figs. 1, 2, and 3.)

The operation itself though slow and tedious is not particularly difficult if the anatomy of the parts is kept in mind, especially the fact that the facial nerve is situated deeply at least an inch beneath the skin. The best guide to the facial as noted by Coleman (1) is the small branch which it gives off to the posterior belly of the digastric muscle. Division of the tip of the mastoid process to turn back the anterior margin of the sternomastoid muscle as suggested by Halstead (4) is not always necessary and was not done in the first of the two cases. The hypoglossal nerve can be brought up to the facial with less tension by passing it in front of the digastric (see Figs. 4 and 5) rather than behind it as shown by Gibson. In both of these cases the descendens hypoglossi was divided and its central end sutured to the peripheral end of the divided hypoglossal (see Fig. 6). The result in each case could be classified as fair only. The paralysis of the tongue was not a particularly serious matter and a certain amount of this paralysis still remains.

The regeneration of nerve to the tongue does not seem to compare with that of the facial nerve.

The operation itself is only the beginning of the treatment and this fact must be impressed on the patient in such a way as to avoid any subsequent disappointment that results are

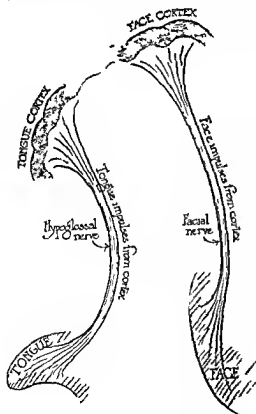


Fig. 1. Normal path of facial and lingual cortical impulses. (After Gibson.)

slow in showing themselves. Complete co-operation is essential. Massage of the facial muscles is instituted once a day beginning 10 days after operation and a small faradic battery is used twice a day, one electrode being held in the hand and the other placed just below the lobe of the ear. In about 60 days the patient senses the fact that the face "feels different" and as the first patient expressed it, seems to be more alive than before and not so flabby. A little later a twitch is felt in the muscles in front of the ear when the current is turned on. In 90 days this twitch can be brought about voluntarily by asking the patient to move the tongue from side to side in the mouth and press it against the lingual surface of the teeth. From that time on the patient should practice facial movements in front of a mirror, always keeping within the limit of muscle fatigue. When improvement ceases cannot as yet be told. The first patient writes 19 months after operation that she is still improving. The amount of restoration of

emotional expression seems to depend on two factors: first faithful practice and second the mentality of the patient.

#### CASE REPORTS

**CASE 1.** Mrs. S., age 43 years, was referred by Drs. W. F. Callias and J. B. Potts on March 8, 1924. Three years and 4 months before this time, November 1920, she was operated upon for sarcoma of the middle ear on the left side. Following the operation the left side of her face was paralyzed for 9 weeks and subsequently she recovered completely. Two years and 7 months ago the ear was cauterized with carbolic acid and a small dose of radium administered. This was again followed by facial paralysis. She was beginning to recover when she had a recurrence of the original growth. This was again curetted out and in November 1921 60 milligrams of radium was inserted in the middle ear and allowed to remain for 18 hours. Three weeks later the facial muscles began to lose their power and since that

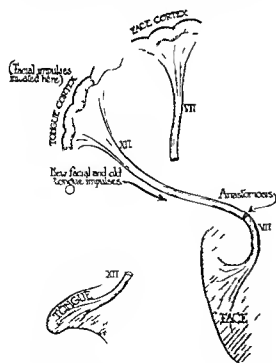


Fig. 2 Path of impulses if facial cortex ceases to function directly (After Gibson)

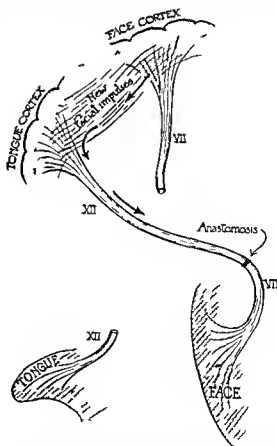


Fig. 3 Path of impulses if facial cortex functions through hypoglossal cortex (After Gibson)





Fig. 4. Wound laid open. Facial, hypoglossal and descendens hypoglossi located and dissected clear.



Fig. 6. The descendens hypoglossi has been divided and its proximal stump sutured to the cut end of the distal stump of the hypoglossal. This was done in 2 cases with only a fair degree of success.

time complete paralysis has developed and is now present. Four days ago a small sequestrum was removed from the mastoid and on examination proved to be non-malignant.

The physical examination was negative except for the wound in the region of the middle ear and mastoid which was partially healed and the facial paralysis which was absolute. There was no motion of



Fig. 7. Facial and hypoglossal nerves have been divided. The posterior belly of the digastric muscle is retracted and the hypoglossal nerve drawn upward and sutured to the facial.



Fig. 8. Photograph of same patient as shown in Fig. 7. 9 and 10 September 15 1924 15 months after operation.



Fig 7 Case 1 March 8 1954 showing face in repose patient attempting to close eyes trying to whistle and attempting to show teeth



Fig 9 Case 1 January 19 1955 20 months and 24 days after operation showing face in repose patient attempting to close eyes trying to whistle and attempting to show teeth



Fig 10 Case August 12 1955 17 months after operation showing face in repose patient attempting to close eye trying to whistle and attempting to show teeth



Fig 11 Case 2 on a (mu) on March 19, 1925, showing face in repose patient attempting to close eyes trying to whistle and attempting to show teeth

any of the muscles of the affected side and in addition the reaction of degeneration was present. The peculiar apparent lengthening of the affected side which is characteristic of long standing cases of facial paralysis was marked (see Fig 7). Though the patient was unable to close the eyelids voluntarily it was interesting to note that they closed completely during sleep. The eye itself was normal except for a peculiar staring look and some excess lachrymation. The patient has been very careful of the care of the eye and thus has escaped any disagreeable symptoms.

In spite of the long duration of the paralysis an operation was performed on March 12, 1924, and an anastomosis between the proximal end of the hypoglossal and the distal end of the facial nerves was made using very fine silk sutures which passed through the sheath of the nerve only. An anastomosis was also made between the proximal stump of the descendens hypoglossi and the distal stump of the hypoglossal nerves. Because of the thickening of the tissues due to the radium the dissection was somewhat difficult. Postoperative recovery was uneventful except for a complaint of swelling of the left side of the throat and soft palate which lasted for a few days. The wound healed by primary union and the patient left the hospital in 10 days. The paralysis of the tongue proved a little troublesome in eating for a few weeks but is at present not noticeable.

Massage and faradic electricity were begun and the patient returned home to Texas after being instructed in the technique of their use. In June she writes: "On about May 4 I began to notice a deep pulsation of the nerve when I used the battery. This gradually increased and on May 5 I noticed an outward pulsation near the ear. Since then this pulsation has continued when the battery is used. The left side seems less tense and tight than it did. The first voluntary motion occurred when she tried to move her tongue against her teeth and from that time on improvement has been continuous (see Figs 8 and 9).

The last photographs were taken on August 12, 1925 (Fig 10) 17 months after operation and a month later she writes: "Mr S. says there is a slow gradual improvement in the movement of my mouth. I can feel that the lower left corner feels less tight."

CASE 2. Miss W. W., age 19 years, was referred by Dr. W. F. Callahan on March 14, 1925 (see Fig 11). She gave a history of having had a running ear on the left side for 13 years. In September 1923 she began taking treatments for this but without benefit. In February 1924 she was operated upon for left mastoid disease. Two days after the operation she noticed weakness of the left side of her face which increased to complete paralysis and there has been no return of function. Physical examination: negative except for a completely healed mastoid wound and the facial condition. There is complete paralysis of the muscles controlled by that portion of the facial nerve which supplies the lips and the lower part of the face. There appears to be slight motion of the eyelids on the left side but no motion of the left side of the forehead.

At operation on March 16, 1925, a double nerve anastomosis was performed. The technique was essentially the same as that used in the previous case except that the tip of the mastoid process was chiselled through and turned back in order to give sufficient exposure. The facial nerve did not seem appreciably changed either in form or consistence although it appeared to be a little smaller than the normal. On stimulation of the nerve there is a slight response in the muscles of the eyelids but the remainder of the face continues to be completely motionless.

Convalescence was uneventful and the wound healed by primary union. Ten days after operation she was permitted to return home after being instructed in the use of massage and electricity. April 13 the tongue is recovering. She eats and talks better. There is no motion of the face. May 25 there appears to be slight motion returning in the lower lip. The eyelids close better. June 22 a letter says: "I am beginning to notice a change in my face. For



Fig 1 Case 2 September 17 1925 6 months and 1 day after operation showing face in repose patient attempting to close eyes trying to smile and attemptin to show teeth

one thing it feels different in some way And another thing is when I first get up in the morning the corner of my mouth jumps That is all I have noticed so far

July 1 a letter says Sometimes I can move the left side of my mouth so that both sides look the same August 25 she writes I can use the left side of my face to quite an extent now On September 17 1925 the patient came to Omaha and the photographs (Fig 12) show the condition at that time She still has a little difficulty with the tongue Her speech is a little imperfect especially when she uses the labials At this time she was quite discouraged but on November 29 1925 she writes

I have noticed while treating it with battery that my upper lip pulls upward as if something was pulling it and while practicing in front of a mirror I can do it voluntarily sometimes but not always My left eyelids have been twitching a good deal lately

Judging by the result in these two cases it seems fair to assume that this operation will not only restore facial symmetry and voluntary motion to the facial muscles but also bring about the return of a certain amount of emotional expression the amount depending largely upon the mental development of the patient

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## SINUS PLURICRANII (STROMEYER)

REPORT OF A CASE. REVIEW OF THE LITERATURE<sup>1</sup>

By ISIDORE COHN, M.D., F.A.C.S., NEW ORLEANS, LOUISIANA.  
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THE case which forms the basis of this report belongs to a group described as a clinical entity by Stromeier in 1850. Since the original presentation at least 38 separate articles have appeared in German and French literature. I have been able to find only two recorded cases in our literature and both were observed by one of our distinguished fellows Dr. Harvey Cushing. His cases differ from the majority in that they were associated with an intracranial tumor.

Such difference of opinion is found in the literature with regard to every phase of the subject from title to treatment that it may not be amiss to report my case in detail with a summary of previous reviews of collected cases. It will not be my purpose to collect all of the recorded cases as this has been done by Wislicenus 1869, Lannelongue, 1886, and Mueller 1912. Only such cases will be presented as seem to have a bearing on the development of the subject.

## AUTHOR'S CASE

J. M., aged 34 years, was first seen in the Surgical Clinic of Toussaint Infirmary where the following notes were made: Patient complained of a lump on the back of his head which he had noticed for the past 2 months. He had severe headaches and the pain in his head was always exaggerated when he stooped over or leaned back. In the upright position he had no pain.

**Physical examination.** Patient was fairly well developed and well nourished. The body surface was covered in an irregular symmetrical way with small hard subcutaneous fibromata (von Recklinghausen's disease). The skin otherwise presented no abnormality; reflexes were normal and there were no glandular enlargements. Examination of the head and neck showed a small mass which was not adherent to the skin. The skin presents no redness or other evidence of recent inflammatory disturbance. The mass disappears on pressure and with this disappearance the examining finger seems to drop into a small opening in the occipital bone. When pressure is released the soft mass reappears.

The mass does not pulsate and it is not expansile in character. A radiographic examination of the skull shows an opening apparently in the region of the lateral sinus. The blood vessel markings within the skull are very distinct.

Patient was admitted to hospital for observation June 27, 1922. Pre-operative diagnosis: meningocele. Postoperative diagnosis: diverticulum of lateral sinus and anomalous opening in the skull communicating with the jugular vein.

**Operation.** A convex incision was made about 4 inches in length following the hair line, the upper limit corresponding to the right mastoid and extending to the midline posteriorly. The skin and pericranial tissues were dissected away from the tumor. The characteristics of the tumor could then be determined. The mass was about 2 inches in diameter, its walls were thin and through them in the mass could be seen movements resembling an eddy. The caliber of the tumor was irregular as a result of constrictions on the surface. There was no expansile pulsation and no thrill. Believing at that time that I was dealing with an aneurysmal varix of the lateral sinus I asked Dr. Matas, chief of the department, to see the patient. He advised that we try to free the mass from the pericranial tissues and if possible to ligate it at its base. The walls of the mass were carefully dissected away from the underlying bone. The jugular vein was ligated at its point of communication with the sac of the tumor mass. There was some bleeding from the sac but we were able to twist it on itself until a small pedicle was formed which we were able to ligate with the skull. An opening in the skull large enough to admit the tip of the little finger was the means of exit for the tumor mass. The pericranium was undermined and the opening closed over by an overlapping flap. The skin was sutured with silk worm gut and plain catgut.

**Laboratory findings.** Two pieces of tissue each 2 by 1 centimeter, red in color, irregular in outline, soft in consistency were examined. Both pieces of tissue were blood vessel which had been split longitudinally. The walls of the tumor were connective tissue lined with endothelium (Lanford).

**Postoperative course.** On June 29, 1922, the first day after operation the record shows no nausea or dizziness. He has a slight headache but the pupils remain equal and there is no cranial nerve volume and rate are good. On July 4 the dressings were changed and the sutures removed. The wound had healed by primary union. Patient left the hospital on July 8 and reported to the clinic for observation during the following few weeks.



Fig. 1. Photograph showing line of incision.



Fig. 2. Roentgenogram of patient.

**Follow-up notes.** June 25 1923. Patient reports that he has been feeling well since operation. He has not noted a recurrence of the swelling but there is a funny feeling on the right side of the head when he raises anything heavy. Examination shows that the scar is covered by hair and no recurrence of swelling and no induration along the course of the jugular vein are found. An anomalous opening in the skull can be palpated.

February 19 1925. Recently patient has complained of top of his head (by this patient refers to the occipital region) and some dizziness at times when working. Examination of the site of the previous operation shows the scar to be smooth and not elevated. The mass which he complains of is not adherent to the skin and is slightly movable. Diagnosis: neurofibromatosis.

Operation March 2 1925. To the right of the posterior midline there are large vascular channels everywhere. Two neurofibromata were removed. The specimen was sent to the laboratory.

August 8 1925. On the right side of the head at a point about 6 centimeters from the nasion and just below the level of the supra-orbital ridge a depression large enough to admit the tip of the index finger is found. The edge of the depression is irregular. The skin covering the scar of the original operative wound is freely movable over the skull. The patient is free of symptoms.

After a careful review of the literature it seems to me that this case belongs undoubtedly to the type of Stromeyer's sinus.

**pericranium.** The outstanding features of the case are:

- 1 The vascular pericranial tumor communicated directly with the lateral sinus through an anomalous opening.
- 2 The anomalous opening was probably congenital in origin.
- 3 It was not associated with the history of trauma.
- 4 The association of this tumor with von Recklinghausen's disease is an unusual finding. Whether there is any relationship between the two is impossible to say, but it offers unusual opportunity for speculation.
- 5 With the exception of headache and discomfort when leaning back or stooping forward the patient suffered no inconvenience.
- 6 There was no bruit or expansile pulsations.
- 7 The walls of the tumor were lined with endothelium.

The significance of some of these characteristics will be better appreciated after reviewing some of the reported cases. The cases which prompted Stromeyer to suggest the term sinus pericranii were reported by him in the *Deutsche Klinik* 1850.

The first of these concerned a boy of 6 years who during his second year had fallen from a considerable height upon his head and sustained a depression of the sagittal suture. At its deepest point the depres-

sion measured approximately 2.5 millimeters. The entire area of depression of bone about 2.5 square inches in extent was covered by a sanguineous cyst which when filled projected for approximately 3 millimeters but when empty, permitted of free palpation of the bone and of recognition of the defective formation of its outer table. Turgescence of the cyst was increased by all factors which induced congestion such as crying, coughing, inclination of the head, compression of the jugular veins, etc. With the child in the usual position no fluid was observed in the region of the depression.

In the second case the patient a man of twenty exhibited above the left eye a congenital tumor treatment of which by physicians consulted by his parents immediately following his birth had proved ineffectual. The tumor which according to his statement presented comparatively the same dimensions as in early childhood extended from the glabella for a distance of 1 inch toward the left and from the arcus superciliaris for a space of 3 millimeters above the beginning of the growth of hair. It involved an area of approximately 4 square inches and when filled projected about 1 inch beyond the surface of the forehead. This occurred only on exertion when the patient stooped, coughed or sneezed or following compression of the jugular veins under the influence of heat and as a result of all factors which impelled the blood towards the head or impeded its return. Near the outer extremity of the arcus superciliaris was felt through the emptied tumor a depression in the frontal bone which suggested loss of substance of the bone and at the same point an area where apparently a moderately large foramen existed. The patient experienced no discomfort except when he wore a heavy head covering or overexerted himself whereupon vertigo and a sensation as of rupture of the distended tumor ensued. Color of the skin remained unaltered even when the tumor was filled. The latter was readily evacuated by pressure and under the influence of the factors referred to above became filled within 30 seconds in which condition it appeared sharply defined and entirely symmetrical.

In the opinion of Stromeyer the above described phenomena indicated clearly that in these cases filling of the sac with venous blood occurred, and that a portion of the external table of the frontal bone was lacking. 'An attempt to remove or otherwise to treat the tumor was regarded as useless and dangerous and was therefore not made.

It is obvious that Stromeyer recognized that the conditions described by him could result from congenital anomalies or follow trauma.

Confusion still exists in regard to the type of case which Stromeyer included in

his original description. This may be observed from the following quotations:

Achilles Mueller Stromeyer drew his conception of the disease picture from a case of Hecker and from two cases with which he himself worked in which as a result of a trauma a vein was torn at its point of departure from the emissarium. The blood from it flowed under the periosteum and since the vessel could not retract itself within its rigid bony canal the bleeding was not arrested. The wall which surrounds the outpouring of blood will gradually become clothed with connective tissue the cavity thus created remained permanently enclosed in the circulation and in permanent connection with the veins of the skull. There are a large number of cases which certainly cannot be cleared up by the explanation given by Stromeyer but which must be referred to congenital or perhaps even acquired, vascular anomalies.

Borchard in 1916 reiterated the conception of the pathology of sinus pericranii attributed by Mueller to Stromeyer.

As late as 1924 Sudhoff did not realize that Stromeyer included the congenital type of tumor in his original description as is evidenced by the following: 'Many conditions are designated as sinus pericranii which do not have the exact picture described by Stromeyer. He means by it only a subperiosteal hematoma on the skull which occurs through the tearing of a vein by its protrusion through an opening. This condition then always requires trauma as a causal agency.

In 1851 Dufour without knowledge of Stromeyer's contribution reported the following case under the title of 'New Variety of Blood Tumor.

After careful consideration of all of the then available classifications of tumors of the vault of the cranium he proposed the term osteovascular fistula. None of the reports are more elaborate in detail therefore a full abstract is appended. Particular attention is directed to the autopsy findings.

Dufour's case. In 1799 during an assault on a fortification he was struck on the right lateral portion of the forehead about 3 centimeters from the

median line. He was rendered unconscious at once and was carried off the battle field. He did not regain consciousness for 24 hours. The surgeon who treated him said that he had a fracture of the skull. The ultimate result of this wound was that he was incapacitated from following his profession of a soldier. When he leaned forward with his head toward the ground there was formed a swelling the size of a nut at the site of the lesion. This swelling was violet in color and disappeared when he raised his head.

In 1847 the surgeon M. Hutin made a detailed examination of all the living veterans and he took a great interest in this case. He found no apparent scar but there was a very evident depression due probably to the result of absorption of a part of the diploe. The sac which was formed of very thin skin was not apparent when the patient was in the upright position seated or lying on his back but when he leaned forward the sac became evident and was about the size of half an egg. It was livid in color due to the presence of blood and no doubt was formed in the same manner as cysts are usually formed in contused tissues. It could not be determined whether there was an opening into the superior longitudinal sinus.

On October 28, 1851, he was admitted to the infirmary for erysipelas of the neck and upper part of the thorax complicated with chronic bronchitis. In spite of energetic treatment the disease ran its course and patient died November 3.

The autopsy was performed November 5, 36 hours after death. The cranium showed nothing abnormal as to the size or protuberances. On the forehead 2 centimeters below the hair line and to the right of the median line there was a small cutaneous area about 2 centimeters in diameter which was distinct from the rest of the skin by its slightly pinkish color, its fineness and its wrinkling. It corresponded to a depression of the bone which was very evident on palpation. When the head was placed in a very low position the tumor could not be made to appear.

The brain was normal of firm consistency and was without traces of old or recent areas of apoplexy. The white and gray matter were quite distinct from each other. The vascular network of the pia mater did not show any infiltration and was only moderately injected. The cerebral convolutions were easily detachable even in the vicinity of the lesion. This was not true of the membranes themselves. At 3 centimeters from the falx cerebri on the right side the visceral layer of the arachnoid was lined by the pia mater and adherent to the parietal layer and with the dura mater. On stretching these pathologic tissues a few drops of blood ran into the arachnoidal cavity. Up to this point the dura mater was easily separated from the cranial vault. At 3 centimeters from the falx cerebri separation could not be accomplished without rupturing the adhesions which were present. It was then found that there were many reddish points on the dura

mater which appeared to be the orifices of gaping vessels. In the bone and opposite these vascular mouths there were small solutions of continuity in the tables of the bone. Water poured into this small space was seen to pass promptly under the external skin and the thin portion of skin easily became distended. The injection of water or the insufflation of air through the superior longitudinal sinus as well as the introduction of bristles in the venous canals emanating from the same sinus and their penetration to the site of the lesion showed that there was a pathological communication between the sinus and the openings in the bone and hence into the external sac. It should also be mentioned that the caliber of the vessel appeared to be slightly enlarged and that it was filled with a long reddish, fibrous clot.

The primary etiological factor in this case was trauma. The first symptoms were those of cerebral concussion complicated by direct fracture. Later there was the formation of a sac containing blood. This sac formed a soft non-pulsatile tumor which appeared when the head was inclined forward and disappeared when the head was returned to the upright position. The skin was never affected as to its continuity but it gradually underwent a modification which reduced it to the thinness of a sheet of paper. The skin was sufficiently transparent to allow the first surgeon to diagnose the presence of blood in the tumor. Immediately after the blow there was a depression or in the bone at the site of the contusion. This depression was the primary lesion the first link in the pathological chain of events. It is probable that the external table alone was fractured, the inner table remaining intact but being subjected to the pressure of bone splinters.

The next question is whether the sac was formed at first or was only secondary. The autopsy findings speak in favor of a secondary development of the blood tumor.

The successive phenomena could have occurred as follows: depression of the surface of the frontal bone, obscure osteitis and interstitial absorption at the expense of the tables and diploe of the bone, propagation of the inflammatory and adhesive nidus to the corresponding portions of the meninges, extension of the ulcerated processes to the meninges increasing the caliber of the vessels or leading to the formation of new vessels, finally there were established communications between the arachnoidal vessels and the canals emanating from the superior longitudinal sinus with the openings in the rarefied bone and with a circumscribed portion of the external skin, the latter becoming distended by the effusion of blood in virtue of physical laws.

In the discussion of his findings Dufour says: "The reducibility of the sac must be considered in the classification of this lesion which must be considered as a blood hernia."



of the vault of the cranium by communication of the meningeal vessels with the external skin by means of an opening in the bone."

In 1869 Wislicenus in his inaugural dissertation, Zurich presented two cases which came under his observation and he collected from the literature 26 cases. The cases of Wislicenus are as follows:

**CASE 1.** A boy of 21 years with negative family and personal history presented a congenital tumor upon the forehead which at first completely covered the left eye but shortly after birth diminished in size and left the eye free. Fourteen days later however the tumor assumed the size which it exhibited at the time patient was admitted to hospital. During attacks of laryngitis from which the patient suffered frequently the tumor swelled became tense and the skin over it appeared bluish. There were no pains headache or vertigo. The tumor caused no disturbances even when filled with blood and it disappeared readily on pressure. It involved the entire height of the forehead and extended from the upper margin of the orbit to the hair line beyond which it penetrated for a short distance so that its upper portion was covered with hair. The tumor extended horizontally from the median line of the forehead to the anterior border of the temporal fossa its horizontal diameter measuring 6.5 centimeters its vertical diameter 5 centimeters its height 2.5 centimeters and its circumference at the base 19 centimeters. A shallow furrow divided it into two parts.

When the patient wrinkled the forehead the tumor appeared to be located below the frontal muscle and appeared to pulsate synchronously with the radial pulse. Palpation revealed fluctuation and a tumor of soft consistency. On more careful palpation it was found that at several points the tumor was composed of small irregular bodies with smooth surfaces. Its base was irregularly humped and between the humps there were irregular depressions in the form of fissures. The tumor increased in size with all activities which caused rushing of blood to the head as stooping coughing pressure and compression of the jugular veins. Compression of the carotids exerted no influence upon the extent or degree of filling or pulsation of the tumor. Circular compression had no influence upon the size of the tumor therefore involvement of the branch of the temporal vein did not exist. This was evidenced also by the fact that pressure upon the tumor did not cause distention of the branch. A direct communication between the tumor and the dural sinus was here assumed and from observations it was inferred that the communication was effected by means of a lumen of considerable size since the contents of the tumor were evacuated in so short a time. It was believed highly probable that the tumor communicated with the superior longitudinal sinus.

**CASE 2.** A female factory worker aged 15 when a child 35 weeks old had fallen downstairs. She was picked up unconscious and for several days had remained in a stuporous condition. Examination revealed upon the occiput over the region of the scar a markedly prominent tumor and a fissure in the bone which corresponded in length and direction with the injury inflicted by the fall. The case was diagnosed at that time as fracture of the cranial bones and the death of the child was predicted. The skin above the tumor was incised and a quantity of dark blood was evacuated. The child was treated in the hospital and subsequently recovered but later on had a violent convulsion which continued for 5 hours. The mother stated that the edges of the fracture then became more and more separated.

When seen by the author the patient complained only of frequent headaches particularly after stooping but had never suffered from vertigo or from pains in the region of the tumor. General examination of the patient was negative. A moderately extensive area of pulsation almost entirely covered by hair was noted upon the posterior portion of the left parietal bone and the left half of the occipital bone. This area was 10.5 by 3.5 centimeters. Pulsation was most marked in the lower posterior portion and was somewhat less evident in the upper anterior portion. The overlying skin was of normal color and was thickly covered with hair. Palpation revealed a deficiency of bone over the entire area of pulsation. Here the outer table of the bone appeared to be absent. The entire area of depression was divided into six fields by five transverse ridges of bone. No abnormally distended vessels either veins or arteries were found in the region of the tumor. Pulsation was visible as well as palpable. There was marked fluctuation. The contents of the tumor were readily evacuated by pressure. No vertigo headache or convulsions. There was no discomfort due to the tumor. Filling was least evident with the head in the erect position. Bowing stooping coughing and pressure caused filling of the tumor which upon cessation of such activities resumed its natural size. Compression of the left carotid caused the tumor to diminish in size and pulsation to become weaker while compression of the right carotid exerted no influence either upon size or pulsation. Compression of the right jugular produced marked swelling of the tumor and compression of the left jugular vein produced only slight swelling. This varying influence of both jugular veins led to the assumption of the existence of an abnormality of the sinus of the dura mater.

This author carefully considered all the points of difference expressed in the literature with regard to the condition. He expressed preference for the name sinus pericranii because it can only mean the pathological form as there is no sinus on the outside of a normal cranium.

The structure of the walls of these tumors anatomic location, contents, symptoms, differential diagnosis as presented by Wischnus is so well done that it will be well to quote rather extensively "The structure of the tumor walls depend on their origin. Either they have walls of their own from the beginning (as in dilatation of an emissary vein) or they have at first no walls of their own (traumatic) the blood escaping into the soft parts of the skull, a capsule being formed later."

The contents of this tumor is always venous blood. The bone below the tumor is frequently affected. It may be either depressed by a trauma or through resorption of the bony substance from continued pressure of the tumor. A communicating opening in the bone could only very rarely be demonstrated.

This last statement can readily be understood because no cases had been operated upon up to this time and only a few had come to autopsy.

The next statement of this author is of particular value since it is prophetic with regard to the curative method of treatment. He says in his discussion: "A communicating opening is only of real value if closing it prevents a reappearance of the tumor after a reduction of the latter. In most cases a communicating opening represents the only connection of the tumor cavity with the venous circulation. In spite of this statement more than 30 years elapsed before the first successful operation was done for the cure of this disease by Franke."

The forehead is given as the most frequent site next the sagittal suture then the occiput.

"The tumors are usually invisible in the erect position. In some cases they appear only on bending forward or any other movement retarding the return of the venous blood. The size varies greatly. The skin covering the tumor is sometimes so thin that the contents of the latter give it a bluish tint. The consistency of the tumor is always soft and at times a fluctuating area is elicited. Pressure causes the tumor to disappear. Compression of the jugular vein

has a distinct influence on the fullness of the tumor. Its volume increases considerably. The patient usually suffers very little. The growth of the tumor is usually slow."

"Differential diagnosis is declared to involve especially the distinction of pericranial sinus from meningocele and encephalocele. Absence of hydrocephalic symptoms, bluish coloration of overlying skin, detection of a murmur, absence of indications of cerebral pressure on compression of the tumor and of a pedicle, more rapid and extensive increase in volume of pericranial sinus through inclination of the head or compression of the jugular veins, verification of firmer content, and slow growth are all said to exclude existence of meningocele and to indicate the presence of pericranial sinus in a patient, while in the differential diagnosis between pericranial sinus and encephalocele the following facts should be taken into account, namely that the latter is as slightly transparent as the former, that encephalocele may exhibit a higher degree of resistance than pericranial sinus and usually fails to disappear completely on pressure that the aperture of communication with the internal portion of the cranium is larger in encephalocele than in pericranial sinus that encephalocele is almost invariably congenital, and children thus afflicted rarely live long."

In spite of his wonderful study of the subject we find Wischnus making this statement: "A conscientious medical man will therefore never think of operating after the diagnosis of sinus pericranii has been made. It only remains to try to influence the tumor to disappear gradually by long continuous pressure (so far never successful) or to prevent its growth by a suitable apparatus and finally to protect it against traumatism."

Lannelongue in 1886 reported one case and discussed all available cases in the literature. The personal case of Lannelongue was a child who had a soft irreducible tumor on the cranium which was diagnosed angioma. At autopsy it was found that this tumor had a pedicle which extended through the membrane between the two parietal bones and communicated with the longitudinal sinus by means of large veins.

of the vault of the cranium by communication of the meningeal vessels with the external skin by means of an opening in the bone.

In 1869 Wislizenus, in his inaugural dissertation Zurich presented two cases which came under his observation and he collected from the literature 20 cases. The cases of Wislizenus are as follows:

**CASE 1.** A boy of 11 years with negative family and personal history presented a congenital tumor upon the forehead which at first completely covered the left eye but shortly after birth diminished in size and left the eye free. Fourteen days later however the tumor assumed the size which it exhibited at the time patient was admitted to hospital. During attacks of laryngitis from which the patient suffered frequently the tumor swelled became tense and the skin over it appeared bluish. There were no pains headache or vertigo. The tumor caused no disturbances even when filled with blood and it disappeared readily on pressure. It involved the entire height of the forehead and extended from the upper margin of the orbit to the hair line beyond which it penetrated for a short distance so that its upper portion was covered with hair. The tumor extended horizontally from the median line of the forehead to the anterior border of the temporal fossa; its horizontal diameter measured 6.5 centimeters its vertical diameter 3 centimeters its height 2.5 centimeters and its circumference at the base 19 centimeters. A shallow furrow divided it into two parts.

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This author carefully considered all the points of difference expressed in the literature with regard to the condition. He expressed preference for the name sinus pericranii because it can only mean the pathological form as there is no sinus on the outside of a normal cranium.

the cavity gradually became lined with connective tissue and finally the cyst appeared and formed an appendix to the vascular system

It will be noted that the walls of the traumatic type have a connective tissue lining and the congenital tumors have an endothelial lining

Arnheim expressed the very conservative attitude with regard to treatment Witness

"In Arnheim's opinion on account of the intimate connection with the sinuses of the cranium, treatment should at first be restricted to methodical compression and a plastic operation should be resorted to only in case of necessity

Compare the above with P Hirsch's expression only surgery may be considered, the operation to consist of ligature of the veins or suture and the osteoplastic closing of the bone fissure His case report follows

The patient is a man 47 years old who for 25 years had noticed that when he stooped a small tumor was noticeable on the left side of his forehead This had given him no trouble at all until during the last year when the tumor had become larger and lately the patient had complained of headache and dizziness On the left side of the forehead there was a small depression which felt as if the bones of the forehead itself were excavated In the vicinity was a proliferation of the bone a mound which was sharply limited laterally which ran off toward the middle With the finger in this cavity one could feel a small fissure through which occasionally pulsation could be felt The patient was then asked to stoop The tumor was about the size of a plum and fluctuating No pulsation could be demonstrated There was normal skin over the tumor and a few superficial veins traversed the skin When the patient stood up again the tumor apparently went back apparently in the upper portions first while in the lower part the protuberance could still be made out There seemed to be a fluid in this sac.

During the following year Krause and Mueller contributed to the subject The most important surgical contribution is that of Krause who described a carefully planned operative procedure for the cure of sinus pericranii The essential features of this operation are

3 Removal of part of the bony ring around the pedicle

4 Incision of the tumor

5 Closure of the opening by a flap which consists of skin perosteum and bone

Case report follows

In this case the patient when in the erect position exhibited in the middle of the forehead a depression which was on more careful palpation revealed as a fissure in the bone of 27 millimeters in length and a few millimeters in breadth On bending a swelling appeared gradually became pulsating then markedly inflated without pulsation and passed over tightly filled veins The same phenomenon was produced by compression of both jugular veins and also when the patient strained or coughed The tumor was diagnosed as pericranial sinus (Stromeyer) Since with the patient in the dorsal position the tumor disappeared the jugular vein was compressed and the tumor marked out with the knife Following loosening of the cutaneous flap a circular incision was made around the entire sinus together with the perosteum the latter was incised as far as the bone and the wall of the sinus was pushed aside with the raspatory A pedicle which extended in an inward direction was encountered near the fissure The bone in the region of the pedicle was removed and the cranial cavity opened whereupon it was perceived that the pedicle was closely united to the longitudinal sinus A flap of skin perosteum and bone was formed and laid over the defect while the first cutaneous flap was sutured in its place

Weiting's case, an abstract of which follows resulted from trauma The recital of this case should be of interest because of the unusual operative procedure which consisted of cauterization of the perforations with a view of establishing adhesions

In a coachman aged 20 years who had sustained a depressed fracture of the right parietal bone the author noted on forward inclination of the head the appearance at the site of the depression of soft fluctuating protrusions which were readily reducible through pressure Subjective manifestations consisted of a sensation of vertigo and headache Focal symptoms were absent A tentative diagnosis of venous blood spaces communicating with the inner regions of the cranium (probably as the result of laceration of the longitudinal sinus) was confirmed by operation In the shallow region of the depression the skull cap was reduced to the thinness of paper and at five or six points revealed cribriform perforations through which communication existed between venous epidural and extradural blood spaces and those situated in part below and in part within the perosteum Pressure in these blood

- 1 Circular incision
- 2 Separation of the perosteum from the skull at a distance from the line of the incision

He found twelve congenital cases in the literature. The remainder were traumatic in origin.

He was of the opinion that direct compression was the best method of treatment. He further expressed the belief that if the growth is continuous and rapid, extirpation should be the method of choice.

The first successful operative case was reported by Franke 1902. An abstract of it follows:

A serving maid 20 years old with negative personal and family history in early childhood had behind the right ear a slight depression in the bone. Later she observed that in the prone position a soft tumor which was readily displaceable appeared upon the right posterior half of the cranium and at first had caused no disturbance but had a few years previously provoked headache and had gradually increased in size so that the patient was unable to stoop without provoking extremely severe pains which had finally become so intense as to render her unfit for work. Application of iodine was prescribed without result.

Examination revealed a well nourished female of healthy appearance who presented upon the upper posterior portion of the cranium a soft superficial slightly fluctuating depressible tumor covered with normal skin. It was painless on pressure. A shallow depression in the cranium was palpable. Following removal of the hair the tumor appeared more prominent with the patient in the half sitting position and with slight stooping it exhibited an uneven surface.

On bowing the head the tumor increased markedly in size and the skin which had previously appeared normal assumed a slightly bluish tint. Slight pulsation of the tumor was then marked but when the patient returned to the erect position it disappeared almost entirely and no longer pulsated.

A slight globular pulsating prominence was observed behind the right ear about 1 centimeter from the insertion of the auricular muscle and some what above a horizontal line drawn through the upper wall of the external auditory meatus. A tentative diagnosis of diffused reticulated angioma or blood cyst was made.

At operation a longitudinal incision was made over the tumor and a dark brownish red membrane was exposed and freely dissected away from the anterior and inferior margin of the tumor. An attempt to detach this membrane from the roof of the cranium caused laceration of the former and permitted the release of a large stream of venous blood which was checked by compression with tampons of iodoform gauze. Efforts to detach the cystic wall at other points led to repeated hemorrhages. The author was about to discontinue the operation on account of impending shock and salt

solution was administered however the operation was continued and on careful removal of the tampon a circular aperture which permitted the insertion of the tip of the finger was encountered at the anterior end of the tip of the depression in the cranial roof. No free communication with a sinus was remarked at these points and no angiomatous or cavernous degeneration was noted either in skin or bone surrounding the cyst. The incision was closed by means of sutures. The openings in the cranium were closed with tampons of iodoform gauze and a tight compression bandage was applied.

It will be noted that a pre operative diagnosis of sinus pericranii was not made. The operation consisted of incision, evacuation of the contents and tamponade.

Six years later (1908) Arnheim presented

A male patient aged 20 years with tumor of the soft parts over the right frontal bone which was attributed by the latter to a fall upon the forehead sustained some 6 years previously. On account of other injuries suffered in the same fall the patient was obliged to remain 3 weeks in bed on arising from which he noted for the first time the existence of the tumor which was declared to have retained meanwhile its original character. The tumor itself varied in size according to the position of the head. It was barely visible when the head was held erect and appeared as if withdrawn into the cranium leaving in its place a depression which admitted the tip of the finger but when the head was inclined in a forward direction or the patient coughed or breathed deeply the tumor attained the approximate size of a walnut and the skin which covered it assumed a bluish red color and revealed marked pulsation. When the patient stood up and pressure was exerted upon the tumor with the tip of the finger it diminished rapidly in size and when all blood had left it an umbilicate depression was felt in the frontal bone.

The chief value to be attributed to this report is the theory of formation of sinus pericranii. While it is true that this is a repetition of Stromeyer's opinion of the formation of traumatic cases, quotation of this in full should be of service.

In the case reported in this article it was assumed that a vein had been torn from its bony support in the periosteum by the fall and that a copious effusion of blood had occurred in consequence and had remained in constant communication with the anterior of the cranium through the vein which was no longer capable of retraction and occlusion in the rigidly walled bony canal. The effusion was in part resorbed but complete reunion of the separated soft parts was impossible since fresh blood continually flowed from the open vein. The wall of

anatomical position of the right sinus transversus there was a longitudinally placed plainly visible tumor 3 centimeters long by 1.5 centimeters high flat and spread out widely over its whole length and covered by skin which was neither thinned nor colored. The tumor felt softly elastic. There was no pulsation. Upon the application of a moderate degree of compression the tumor disappeared slowly but completely into the skull. One could then feel a bony uneven low wall about a depression as large as a finger tip. When the pressure was removed the tumor reappeared slowly but did not attain its original size for several minutes. When he coughed or pressed it it became filled more rapidly. Compression of both jugular veins produced filling of the tumor. If only the right vein was compressed it resulted in no substantial change in the condition. The patient refused to undergo the severe shock of an operation.

This surgeon recognized the value of the operation suggested by Krause.

The outstanding importance of the X-ray as a diagnostic means is pointed out by Borchart. The roentgen pictures alone clear up the whole relationship and provide a viewpoint upon which to base the subsequent choice of the method of operation eventually to be used.

In 1917 Moeng added two cases to the literature.

The first of these was that of a male patient aged 20 years. Four years before he had fallen from a height and had struck the right side of his forehead. As evidence of this there was a swelling. The patient noticed that this swelling stood out when ever he bent his head forward. Recently he had complained of constant headache and dizzy feeling.

On the right side of the forehead could be noticed a slight irregular mass over the bone about the size of a pea. When the head was bent over this place increased to about the size of a walnut. When the head was raised again the tumor entirely disappeared. The X-ray showed no bone changes. At operation there was found a bluish cyst similar to a varix coming out from the bone. The wall of this cyst was as thin as paper and when torn it discharged an amount of fresh venous blood. It could be seen that the bleeding came from three fine openings of needle points in the bone.

The second case is that of a man aged 24 years who could not remember having been seriously ill. On the left side of the head he had always noticed a depression. In this depression there had always been a small protuberance. It could not be ascertained whether his birth had been difficult. He had never had any disturbances attributable to this place in his head. In the summer of 1915 he fell from a munition wagon and struck the left side of

his head. He had not been unconscious and no trouble seemed to have followed this fall. In the beginning of August 1916 he fell from a provision wagon and was for a short time stupefied but not unconscious. He seemed to have no trouble after this fall.

At the end of August the patient noticed that the head became swollen on the left side when he stooped or if he did hard work. At the same time disturbances appeared. He had the feeling as if he were drunk. This feeling appeared if he suddenly stopped when walking fast. At the same time he had severe headaches. Also vomiting appeared and glimmering before the eyes. These troubles decreased somewhat after 14 days in the hospital. The tumor which at first appeared quickly now came more slowly.

The patient is a strong and healthy man on the left side of the head parallel with the sagittal suture 3.5 centimeters distant from this beginning close behind the left frontal protuberance ran a smooth depression 9 centimeters posteriorly. Forward in the depression there was a protuberance about the size of a five pfennig piece only a few millimeters high. This and a small place in the posterior corner of the depression were painful on pressure. The depression was about 2.5 millimeters wide and diminishes toward both ends. When the patient bends the head forward there comes out over the depression a soft fluctuating tumor about 13 centimeters in length and 3.5 centimeters in width toward the back this becomes very narrow. When the head is raised again the tumor disappears. It may also be felt when both venae jugulares are compressed. It takes 45 seconds to fill again emptying takes about 2 minutes. Roentgen ray examination shows nothing abnormal in the bones. It seems remarkable that through pressure of the fingers at different points of the boundaries of the tumor one could not prevent a filling of the blood sac. No opening in the bone could be felt. This leads one to suppose that there are many openings in the bony skull. Communication with the sinus was shown to exist by test puncture which gave venous blood. Treatment can be only surgical.

Sudhoff in 1914 under the title of 'A Simple New Operative Method for Sinus Pericranii' reviewed the literature extensively. Sudhoff cites Demme's and Heineke's classification giving preference to the latter as being clearer. The classification of pericranial vascular tumors according to Heineke is: (1) Varix simplex communicans—a congenital condition caused by anomalies of the vessels. (2) Varix racemosus communicans—a bundle of widened veins likewise congenital. (3) Varix spinus communicans—which follows trauma and is the sinus per-

spaces was at times positive and at times negative according to the position of the head. In order to establish a firm cicatricial adhesion of the scalp to the region of depression the periosteum was pushed back the perforations were cauterized and the galea was firmly sutured over all. This procedure sufficed with slightest pressure in the sinus to prevent the passage of blood, while complete disappearance of subjective disturbances also followed in due course.

After an exhaustive study of the literature particularly with reference to the attempts at classification of various cases into separate groups Mueller concludes 'Clinically the anamnesis offers the chief distinguishing mark in determining whether a tumor is congenital or traumatic. The disease rests with certainty upon a vascular anomaly.' He believes that there is very little justification for dividing the cases into separate groups.

The operative treatment according to Mueller 'must consist in the removal of the sac and the closing of the opening through which it communicates with the interior of the skull.'

#### Mueller's case

A girl aged 13 years sought the aid of the clinic on account of a small swelling which lay in the region of the left parietal eminence and which had lately been the cause of severe pains in the head. When the patient kept the head in an upright position, the swelling was small and scarcely noticeable but when the head was bent either forward or backward the swelling increased to about the size of a walnut. Upon returning the head to an upright position the swelling again disappeared. The tumor was soft and fluctuating. When the patient stood the tumor could be made even smaller than usual by pressing upon it; its contents doubtless going into the interior of the skull. In sneezing and coughing there was an increase in the size of the formation but this could not be brought about by a compression of the *venae jugulares*. There was no pulsation. When the tumor emptied a depression in the underlying bone with a distinct margin could be felt plainly especially in the anterior part. The bony skull under the tumor felt the same as in an impression fracture except that a real defect was present. The roentgen examination showed no unmistakably the depression which could be felt. The Wassermann test was negative. A test puncture showed circulating blood as the contents of the cyst. The patient had had this defect ever since her earliest childhood. The pains in the forehead of which the patient complained were the cause of the operation which was performed under narcosis

by Hildebrand on October 20 1911. The skin above the tumor was cut off in the form of a flap immediately under the scalp there was a sac composed of many bays and a circular incision was made around its base to the bone. In this incision different vessels which led to various places in the vicinity were severed and subjected to ligatures. The whole tumor was then removed from its pedicle together with the periosteum. The flat depression in the bone which has been mentioned was thus brought into view and except that it seemed somewhat thinner than normal the bone appeared otherwise quite normal. Fresh blood flowed in a constant stream but without pulsation from two small emissaries: the one larger and as thick as a pin and the other extremely thin. Since the bleeding did not stop upon the application of tampons the point of an ivory needle was introduced into each of the very fine openings and the shaft then taken off close to the bone. They were then tamponed with iodoform gauze a suture of the skin made and compression bandages applied. Convalescence was smooth.

*Pathologist's report.* The small tumor consisted of fine network with numerous septa. Microscopically it was composed of a great number of narrow canals filled with blood in parts of which an endothelium lining is visible. The formation measured by its histological structure would be designated as a sort of cavernous angioma but of an exceedingly venous character since it is enclosed in the venous circulation. It receives its inflow from two emissaries in the sinus in the interior of the skull its outflow follows the veins of the scalp.

Dorward in 1916 restated the misconception that Stromeyer included only traumatic cases under the title of sinus pericranii as evidenced by the source of the disease is a fracture of the skull caused by a blow from some blunt instrument. The congenital cephalohæmatocoeles which are also regarded as venous angioma by Lannelongue do not belong here.

#### He reports in detail the following case

K. M. 27 years old, had fallen upon the rear part of the head 13 years previously in running upon the ice. Patient had been unconscious for 4 hours but had then returned home alone and had remained several days in bed. After 14 days a tumor had formed fairly suddenly on the right side of the occiput and had continued to increase in size. The size of the tumor increased or decreased with each change of position but after the first year it grew no larger. In case of strong exertion or of bending over the patient felt severe pains on the right side of the neck and across the right side of the head to the right eye.

On the right occiput at a distance of 3 centimeters from the median line corresponding exactly to the

## INTERCOSTAL NEURALGIA AS A CAUSE OF ABDOMINAL PAIN AND TENDERNESS

By JOHN BERTON CARNETT M.D. PHILADELPHIA, PENNSYLVANIA  
Fellow of the University of Pennsylvania Graduate School of Medicine

**N**EURALGIA of the nerves which supply the abdominal walls is a subject which has never received merited recognition in medical literature. It is an exceedingly common affection, and failure to recognize its presence inevitably leads to erroneous diagnoses and often results in futile operations.

The nerves which supply the abdominal walls are the lower six intercostal nerves and the iliohypogastric and ilioinguinal branches of the first lumbar nerve.

Physicians generally are alert to consider and detect intercostal neuralgia in the upper chest wall and yet they commonly fail to consider its possibility or detect its presence in the abdominal wall. Medical practitioners are prone to ignore the fact that intercostal neuralgia causes pain and tenderness over the abdomen which may simulate any one of various intra abdominal gynecological, or genitourinary lesions. I see an average of one or two patients a week and sometimes as many as three new patients in one day in whom fairly competent physicians have failed to recognize the superficial neuralgia and have referred the patients for operation for various non-existent intra abdominal lesions.

In order to differentiate between parietal tenderness and intra abdominal tenderness I have devised a simple two stage bedside test which I have not seen mentioned anywhere. (A) In any patient complaining of abdominal pain and tenderness the examiner follows the classical advice of gaining the confidence of both the patient and his muscles and then palpates in the usual manner. Irrespective of whether the tenderness is parietal or intra abdominal the examiner's fingers as a rule will dip fairly deeply into the abdomen before tenderness is elicited. This deep position of the fingers has generally been regarded as proof that the tenderness is intra abdominal but in a surprisingly high percentage of cases this assumption will prove to be an error as shown

by the next step. (B) The examiner keeps his fingers at the most sensitive area he has discovered on deep pressure and requests the patient to make his abdominal muscles rigid by contracting his diaphragm or by raising and holding his head from the pillow as the patient tenses his muscles the examiner relaxes his finger pressure so that his fingers rise out of the abdomen, and then with the patient's abdominal muscles tense the examiner reapplies pressure with his finger tips and he also may exert a little twisting motion with them. If the case under examination is one of intra abdominal tenderness only, the B stage of test will fail to elicit any tenderness when strenuous pressure is applied over tense muscles. If the case is one of parietal tenderness almost or quite as much tenderness will be elicited by the B test as by the A test.

My clinical experience with this two stage test indicates that parietal neuralgia causes tenderness in all three sensory layers of the abdominal wall i.e. in (1) skin (2) muscles and (3) peritoneum. Palpation by the A test with relaxed musculature elicits the combined tenderness of all three layers, whereas palpation by the B test elicits tenderness only in the skin and muscles, because thoroughly tense muscles protect the underlying sensitive peritoneum from painful pressure. With tense abdominal muscles it therefore happens that even when all the tenderness is in the parietes, the patient often notes distinctly less tenderness in the B test than in the A test.

With the A and B tests as part of the routine in abdominal examination I have been amazed at the frequency with which the tenderness is located in the parietes. Excluding cases of peritonitis I have found tenderness in the parietes more often than in the abdomen itself. In the absence of a complicating peritonitis the great majority of intra abdominal lesions are free from demonstrable tenderness. C. H. Mayo<sup>1</sup> has recently commented on the



crani of Stromeyer, (4) varix herniosus sinus sagittalis—is a bulging of the sinus sagittalis through an opening in the skull

All writers agree with Sudhoff when he states 'The clinical picture is always the same' It will simplify matters greatly if further attempts to differentiate be avoided except as to the etiology

Sudhoff describes the operative procedures which have been used and expresses preference for Payr's operation 'He divides the sinus after he has cut around it to the bone raises it as far as the pedicle ligates the pedicle and closes the opening in the skull with a paraffin or wax plug This is either inserted immediately or else after he has bored a tiny hole in order to locate the origin of the communicating vein Three cases were so operated upon in the author's clinic The result was very good'

#### SUMMARY

1 Sinus pericranii as described by Stromeyer in 1850 included both congenital and acquired lesions

2 The clinical picture is always the same in both types A soft fluctuating, slowly growing vascular tumor of the scalp which communicates directly with an intracranial sinus through an anomalous opening of congenital or acquired origin These tumors as a rule are not evident when the patient is erect, but they become prominent when the patient coughs sneezes compresses the jugular vein or does anything which increases intracranial pressure and which interferes with venous return from the skull

3 The tumor is reducible into the skull

4 A bony defect is evident on palpation

5 The X ray is invaluable as a diagnostic means The anomalous communication is demonstrated beyond question

6 Endothelial lining of the walls of a tumor differentiates the congenital from the acquired type The latter has a connective tissue lining

7 Surgery is the only rational means of cure

8 The procedure followed in this case was suggested by Professor Rudolph Watas

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intercostals and first lumbar. Very often tenderness is present over many more nerve trunks than would be indicated by the area of peripheral tenderness as shown by tests 1, 2, and 3. For instance the area of peripheral tenderness could be explained satisfactorily by involvement of the tenth and eleventh nerves only, yet frequently unilateral or occasionally bilateral tenderness of nerve trunks may be found up to and including the first intercostal. This association of nerve trunk tenderness seems to have been entirely overlooked by the various writers on the visceroparietal reflex. It is a curious fact that intercostal nerves that exhibit tenderness of their nerve trunks and their abdominal terminal branches usually do not exhibit tenderness of their terminal branches which supply the chest wall itself. Exceptionally these chest terminals may be involved and then tenderness by tests 1, 2 and 3 may be found extending from midline in front to midline of the back over the chest as well as over the abdomen.

5 *By pinching flank muscles.* In certain thin individuals it is possible to demonstrate tenderness by picking up a fold of skin, fat and superficial layer of muscle in the flank (iliocostal space at outer limit of abdomen) without encroaching on the underlying peritoneum even when tests 2 and 3 of the same area of skin and of skin and fat reveal normal sensation. In some instances this tenderness is diffuse in the muscles and it is then apparently due to hypersensitive nerve terminals. In other instances the tenderness is circumscribed and is apparently due to sensitiveness of the trunks of the twelfth intercostal and the abdominal branches of the first lumbar.

6 *By pressure over transverse processes of vertebrae.* Frequently when hyperaesthesia is absent in the skin and muscles overlying the vertebrae and tenderness of the spinous processes is also absent deep pressure will reveal tenderness of one or more transverse processes of the vertebrae. Usually the number of sensitive transverse processes is smaller than the number of tender nerve trunks. Occasionally a smaller number of less sensitive transverse processes is found on the opposite unaffected side. The cause of this tenderness is uncertain but I am inclined at present to re-

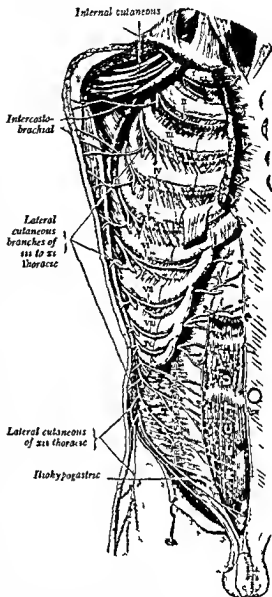


Fig 1. Drawing showing intercostal nerves the superficial muscles having been removed (From Lewis 20th ed. *Gray's Anatomy*)

gard it as evidence of irritative lesions at the intervertebral foramina.

7 *By pressure over remote areas.* When the first and second intercostal nerves are affected their large branches which run to the arm give rise to spontaneous pain or to tenderness or to both in the arm areas supplied by them. Involvement of these two and of other adjacent

amazing hyposensitiveness of areas in the stomach, gall bladder, and appendix despite the presence of extensive disease as disclosed by operation

Intra abdominal tenderness signifies some form of intra abdominal lesion the diagnosis of which does not come within the domain of this paper Parietal tenderness exceptionally may be due to a variety of local lesions as dermatitis cellulitis myositis trauma abscess etc., of the abdominal wall, but they will also be dismissed without further discussion

Usually parietal abdominal tenderness is caused by neuralgia of the lower six intercostal and first lumbar nerves Involvement of a single nerve is rare Bilateral involvement is fairly common Usually several adjacent nerves on one side only are affected Not infrequently all twelve intercostals and the first lumbar as well as additional lumbar nerves and some of the cervical nerves may be involved either unilaterally or bilaterally It is a curious and very striking fact however that almost without exception the only spontaneous pain of which the patients complain is felt in some part of the soft abdomen irrespective of the number of nerves involved Patients almost never volunteer a statement that they have any pain over the rib area and when asked leading questions they nearly always deny rib area pain with the exception that spontaneous pain may be present in the breasts of women They are nearly all convinced their abdominal pains are deep seated, that is inside the abdomen and not in the parietes

The area of spontaneous abdominal pain is usually smaller than the area of abdominal tenderness

In making tests for tenderness comparison should be made between an area of normal sensation and the particular area under examination Usually the comparison is best made by testing corresponding areas on opposite sides of the midline When the lesion is bilateral, an area of normal sensation should be selected over an arm leg neck or upper chest Some of the tests for tenderness require intelligent co-operation on the part of the patient, and are therefore of decidedly less value in mentally incompetent patients

Tenderness due to intercostal neuralgia can be demonstrated in a number of ways

1 *By deep pressure* Tenderness over the terminal branches of the parietal nerves may be demonstrated by the firm pressure of palpating fingers both when the abdominal muscles are relaxed, as in test A, and when they are tense as in test B Usually the tenderness is not uniform throughout the hypersensitive area The most marked tenderness is commonly found along the outer border of the rectus muscle in localized points which probably coincide with the points at which the nerve branches pierce the posterior layer of the rectus sheath

2 *By pinch test* Pinching of the skin and subcutaneous fat between the examiner's thumb and finger is the simplest easiest, and most practical test for ascertaining the approximate area of tenderness An interesting application of this test may be made in unilateral cases in which the hyperæsthesia approaches the midline by picking up a fold of fat and skin on each side of the midline and pinching it between thumb and finger whereupon the patient will complain of pain on the affected side only Another modification of this test consists of pressing skin and fat (without disturbance of peritoneum or muscles) against the inner side of the anterior superior spine of the ilium The area of tenderness as demonstrated by the pinch test is usually smaller than the area of deep pressure tenderness but is usually larger than the area of epigastric hyperæsthesia as shown by the next test

3 *By superficial skin tests* As a rule skin hyperæsthesia is revealed by picking with a pin by stroking with a cotton wisp and by applying heat and cold In exceptional cases all these tests may reveal an area of hyperæsthesia instead of the usual area of hyperæsthesia It is an interesting fact that in these cases of superficial hyperæsthesia the (1) deep pressure and the (2) pinch tests both reveal hyperæsthesia

4 *By pressure on nerve trunks* Tenderness will be found along the course of the nerve trunks supplying the tender area This tenderness is easily demonstrable in the case of the seventh eighth ninth and tenth intercostal nerves and less so in the eleventh and twelfth

region or fracture of ribs endogenous toxins as from canous teeth infected tonsils upper respiratory tract infections pneumonia pulmonary tuberculosis intra abdominal foci of infection, infectious diseases etc exogenous toxins as lead alcohol, arsenic antitoxins sero bacterines etc, and various constitutional affections as anemias blood dyscrasias syphilis diabetes etc. Theoretically an exhaustive painstaking examination should reveal evidence of the underlying disease causing the symptoms of intercostal neuralgia in every case. In practice however it is often impossible to determine the definite cause and frequently two or more causes may be acting together in any given case.

Intercostal neuralgia is more frequent in women than in men and more common on the right than on the left side and it may occur at any age. In childhood and early adult life the common cause is toxæmia from contagious diseases pneumonia and upper respiratory tract infections and the attack usually persists for only a few days. A more prolonged period of symptoms may result from Pott's disease or lateral curvature of the spine. After the age of 25 or 30 years a greater variety of causes are noted.

The symptoms of intercostal neuralgia may be transient or may persist over a period of years in which they may be fairly constant remittent or intermittent or may be subject to repeated exacerbations. The severity of the pain varies greatly in different patients and often also in the same patient at different times. Exceptionally in the acute cases pain may be so severe that heavy doses of morphine are required for its relief. Usually the pain would be quite tolerable in the chronic cases except for its long duration. Ordinarily the pain does not prevent the patient from working at his usual employment and his main reason for seeking advice is often due to a fear that the pain indicates some intra abdominal lesion such as appendicitis gall stones or cancer.

When we consider that intercostal neuralgia may exist from only a few days up to several years may vary in severity from 1 per cent mildness up to 100 per cent vicious severity of pain may involve any one or several of the

twenty four intercostal and the two first lumbar nerves, and in addition other spinal nerves, and commonly may be associated with symptoms of its causative disease we can realize the great diversity in the clinical pictures presented by these patients.

Intercostal neuralgia in so far as it affects the abdominal wall is commonly not recognized and is generally and erroneously regarded as an evidence either of an intra abdominal lesion or of some vague neurosis. Abdominal tenderness due to intercostal neuralgia is usually not demonstrated by the customary method of palpation with relaxed muscles (A test) until the examiner's fingers have dipped more or less deeply into the abdomen. Because of the deep position of his fingers the examiner subconsciously comes to the erroneous conclusion that the tenderness is deep seated and is caused by an intra abdominal, gynecological or genito urinary lesion. Palpation by the B test with the abdominal muscles made tense would prevent this error and demonstrate the parietal location of the tenderness and then further examinations along the lines indicated would reveal additional evidences of intercostal neuralgia. As a rule, the area of abdominal tenderness in intercostal neuralgia is too widespread to be accounted for on the basis of a lesion of a single viscus in the absence of a complicating peritonitis but this fact is commonly overlooked and failure to employ the B test is apt to result in an operation for a non-existent lesion in the viscus which lies immediately beneath the point of maximum parietal tenderness. If the pain and tenderness are of recent origin and fairly severe they are often due to the toxæmia of a late stage of a respiratory tract infection which may still be causing fever tachycardia and leucocytosis. If as usually happens with intercostal neuralgia the pain and tenderness are right sided an emergency appendectomy may be performed on an appendix which does not show any present signs of active disease but the surgeon may theorize that it was linked or otherwise vaguely diseased to account for the acute symptoms. The patient has a somewhat stormier convalescence than the ordinary clean appendectomy but inasmuch as his respiratory infection is past history, the

intercostal nerves gives rise to pseudo angina pectoris and probably also to some of the cases regarded as true angina. The entire arm may be painful and tender when the neuralgia affects adjacent cervical nerves. When the ilio inguinal nerve is involved a band of tenderness on pressure or pinching up to 2 inches in width may be found below and parallel to Poupart's ligament and pinching of the two labia majora simultaneously between thumb and finger may reveal hypersensitivity of the labium on the affected side only. When the last intercostal and first lumbar nerves are affected, there is very commonly found an area very sensitive to pressure over the upper part of the buttock just beneath the crest of the ilium well posterior to the great trochanter. Demonstration to medical consultants of this area of buttock tenderness has proved a very valuable aid in convincing them that the patient under examination has parietal rather than intra abdominal tenderness. I believe this buttock area of hypersensitivity is due to involvement of the iliac branches of the ilio inguinal and iliohypogastric nerves. Textbooks of anatomy describe a fairly large branch from the twelfth intercostal which supplies the skin of the trochanteric region. On theoretical grounds it might be argued that hypersensitivity should be encountered very frequently in the trochanteric region but I have very seldom found it. The usual area of buttock tenderness varies in depth and width. It may be only the size of a finger tip or it may extend laterally for a distance of 2 or 3 inches and may extend downward to a line about on a level with the tip of the great trochanter. Tenderness extending below this level is much less common and when present is due to involvement of lumbar nerves from the second on down. *Meralgia parasthetica* seems to be a very puzzling disease to the ones who have written about it but in my experience it is simply an expression in the second lumbar nerve of the same form of neuralgia as affects the intercostal nerves and it is often found in association with the latter.

The tests which have been described are usually very valuable in making a differential diagnosis between parietal neuralgia and early peritonitis, but the examiner must keep in

mind that under certain circumstances the B test may prove misleading in cases of peritonitis. When peritonitis either acute or as a local abscess involves the anterior parietal peritoneum and particularly if the inflammation having penetrated the peritoneum involves the muscles tenderness may be elicited even when the muscles are tense in the B stage of the test. Again patients particularly multiparous women with very flabby abdominal muscles may be unable in the B test to tense their muscles adequately to exclude an intra abdominal tenderness. If these two possible sources of error are kept in mind, a faulty diagnosis can be averted by a careful analysis of the numbered tests and by finding other characteristic evidences of the intra abdominal lesion. All of the signs of intercostal neuralgia may be associated with peritonitis. Usually, however in peritonitis the tenderness is limited to the abdominal wall and does not involve the nerve trunks the buttocks or the transverse processes of the vertebrae.

For the sake of brevity and for lack of a more suitable designation I am using the term 'intercostal neuralgia' in this paper to include every lesion which can give rise to pain and tenderness in any or all of the twenty four intercostal nerves and the two first lumbar nerves. In a minor percentage of cases intercostal neuralgia may occur as a disease *per se* as for instance from exposure to cold such as occurs in the early spring months when boys go in swimming and lie naked on the riverbank exposed to raw winds. As a rule however intercostal neuralgia is only a syndrome which may be present in any one of a great variety of lesions which involve the spinal cord or the intercostal nerve roots trunks or terminals. The underlying disease may be an irritative lesion of the sensory tracts in the spinal cord any form of spinal meningitis particularly syphilitic and tuberculous a disease of intercostal sensory nerve roots or ganglia as in herpes zoster sarcoma secondary carcinoma tuberculosis or syphilis of the vertebrae various forms of arthritis and osteoarthritis of the spine typhoid spondylitis abnormal curvature of the spine postural strains of spine trauma either direct or indirect to the spinal

ulcer in which a dime sized area of tenderness is sometimes found near the midline in the epigastrium without other coincident signs of intercostal nerve lesion. Late peritonitis may also cause parietal tenderness limited to the abdomen and the tenderness may be present even when the muscles are tense in the B test, but as a rule the nerve trunks, buttocks, and vertebrae are then not hyper-sensitive. These types of cases however are rare as compared to the very common cases of widespread pain and tenderness due to intercostal neuralgia. I believe that further careful study of cases will demonstrate that (1) certain intra abdominal inflammatory lesions may cause parietal tenderness either by toxæmia or by involvement of the abdominal wall, (2) the visceroparietal reflex is at most a very infrequent manifestation and (3) the usual cause of parietal pain and tenderness is intercostal neuralgia independent of an intra abdominal lesion.

In exceptional instances a suppurative intra abdominal lesion other than peritonitis may cause parietal neuralgia but it is then the result of a local manifestation of the constitutional toxæmia rather than the expression of a visceroparietal reflex and the chances are about equal that the parietal neuralgia will be on the side opposite to the suppurative lesion. I believe Mackenzie and his disciples have the cart before the horse when they assume that an intra abdominal lesion must be the cause of parietal pain and tenderness in every case. Acting on that assumption they operate to remove a chronic appendix or chronic gall bladder and because the microscope reveals chronic disease they regard their case as proven whereas a follow up on these cases all too commonly shows a recurrence of pain and tenderness after the patient resumes normal activities. The real test in these cases is not what the microscope shows but whether or not the operation relieved the patient of the parietal pain and tenderness for which he sought treatment. The majority of cases of intercostal neuralgia occur beyond midlife at a time when various forms of intra abdominal pathology have made their appearance and can be demonstrated by exhaustive examinations or by exploratory opera-

tions but the mere presence of such pathology does not prove it is the cause of the intercostal neuralgia. Cases are all too numerous in which repeated intra abdominal operations have failed to cure the neuralgia. Intercostal neuralgia and any intra abdominal lesion may coexist just as a wen of the scalp and an ingrown toenail may coexist in the same patient and except for their geographical proximity they are usually just as independent of one another as regards cause, diagnosis, prognosis, treatment and ultimate results as are the wen and the toenail. In any case of intercostal neuralgia it may be a difficult question to determine whether or not there is a co-existent (although independent) intra abdominal lesion but a careful consideration of the history, symptoms, physical examination, X ray and laboratory findings will lead to a correct diagnosis.

Because of inadequate or misdirected examinations many patients with intercostal neuralgia are labeled neurotics or some similar opprobrious epithet just short of fakir or malingerer and receive but scant attention from physicians and hospitals. A large percentage of these patients are neurotic but that does not excuse the failure to diagnose and treat their intercostal neuralgias. On the other hand the failure to diagnose the cause of long standing abdominal pain and tenderness and the lack of interest shown in treatment are enough to make them "neurotic."

It is a surprising fact that patients with symptoms of long duration as a rule do not attempt to exaggerate their symptoms in the hope of securing more attentive treatment. That their pains are real is evidenced by their willingness to undergo operation after operation in the hope of obtaining relief from their prolonged pain and tenderness. In my experience nearly all the patients who have multiple abdominal scars and are still complaining of abdominal pain and tenderness present definite signs of intercostal neuralgia.

An examination of a patient along the lines indicated in the earlier part of this paper promptly substantiates the claims of the real sufferer and exposes the malingerer because the latter's efforts soon reveal glaring discrepancies between his claims and the anatomical

toxic intercostal pain and tenderness promptly subside within 3 to 7 days and the patient is believed to have been cured of his parietal pain and tenderness by the appendectomy.

It is the patients with intercostal neuralgia in a chronic form who constitute the majority of the cases that are subjected to gastro intestinal X ray studies and who are mainly responsible for 90 per cent of all gastro intestinal X ray examinations proving negative. These same patients are subjected to test meals, bile drainage, cholecystograms, cystoscopies, ureteral catheterizations, pyelograms, vaginal and proctoscopic examinations and various laboratory tests of urine, blood, feces, spinal fluid, etc. in the vain effort to discover the cause of pain and tenderness which are in no way dependent upon an intra abdominal lesion. If as commonly happens all these examinations prove negative the patient is either subjected to a futile exploratory laparotomy or is discharged from the hospital with advice as to treatment which proves barren of results and the patient then starts on his career of entering hospital after hospital to have expensive examinations repeated time after time. On the other hand if examination reveals an intra abdominal lesion its operative correction will very seldom exert any influence upon the course of the intercostal neuralgia and the patient will complain of the same pain and tenderness after operation. During the first few days after operation the patient is reassured by being told that his symptoms are due to the transient pain and soreness of the wound but as he continues to complain up to the minute of his discharge from hospital he is lucky if he escapes the stigma of being called a 'neuritic'. A persistence of the same pain and tenderness for many months induces the patient to seek another hospital where the various intra abdominal examinations are repeated and all of them proving negative the patient is operated upon for 'adhesions' which are seldom found and the intercostal pains and tenderness continue unabated. If the patient is a woman she is quite apt to have three operations: first an appendectomy then a salpingo-oophorectomy and then an operation for adhesions. Thereafter she follows after strange cults, becomes a dope fiend or

if pains are unusually severe commits suicide. Much time, trouble, and expense can be saved patients, physicians and hospitals by spending one minute in employing the A and B two-stage test as a part of the routine examination of all abdomens in which tenderness is encountered. The A and B test in cases of intercostal neuralgia will immediately disclose the fact that the tenderness is parietal and that after exclusion of a possible peritonitis further examinations should be conducted to discover the underlying cause of the nerve lesion rather than to hunt for an intra abdominal lesion which is not likely to be found or if found is almost certainly not the cause of the parietal pain and tenderness.

I believe that the teaching of Sir James Mackenzie and his followers that pain and tenderness of the abdominal wall should be regarded as a visceroparietal reflex indicative of an intra abdominal lesion has resulted in many erroneous diagnoses and needless operations. Mackenzie believes the intra abdominal viscera which are not supplied by nerves of pain sense and therefore when diseased cannot manifest pain in themselves will when diseased send stimuli over a sympathetic branch to the spinal cord and create therein an irritable segmental focus with the result that the normal afferent impulses coming from the skin and muscles over the intercostal nerve to that irritated spinal segment will give rise to painful impressions which are in turn referred over the intercostal efferent fibers to the peripheral tissues. Mackenzie and his disciples have focused their attention upon the comparatively small abdominal area of spontaneous pain and localized tenderness as described under (2) the pinch test and (3) the superficial skin tests and they have failed to realize how widespread the intercostal nerve involvement may be in these cases as shown by tests 4, 5, 6 and 7. They believe the maximum point of parietal tenderness is an index to the particular viscus which is diseased. I have tried out their theories and I have been unable to convince myself of the correctness of their views in the vast majority of cases that come under my observation. Their views may hold good in exceptional cases as for instance, in gastric or duodenal

ulcer in which a dime sized area of tenderness is sometimes found near the midline in the epigastrium without other coincident signs of intercostal nerve lesion. Late peritonitis may also cause parietal tenderness limited to the abdomen, and the tenderness may be present even when the muscles are tense in the B test, but as a rule the nerve trunks, buttocks and vertebrae are then not hypersensitive. These types of cases, however are rare as compared to the very common cases of widespread pain and tenderness due to intercostal neuralgia. I believe that further careful study of cases will demonstrate that (1) certain intra abdominal inflammatory lesions may cause parietal tenderness either by toxæmia or by involvement of the abdominal wall, (2) the visceroparietal reflex is at most a very infrequent manifestation, and (3) the usual cause of parietal pain and tenderness is intercostal neuralgia independent of an intra abdominal lesion.

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It is a surprising fact that patients with symptoms of long duration as a rule do not attempt to exaggerate their symptoms in the hope of securing more attentive treatment. That their pains are real is evidenced by their willingness to undergo operation after operation in the hope of obtaining relief from their prolonged pain and tenderness. In my experience nearly all the patients who have multiple abdominal scars and are still complaining of abdominal pain and tenderness present definite signs of intercostal neuralgia.

An examination of a patient along the lines indicated in the earlier part of this paper promptly substantiates the claims of the real sufferer and exposes the malingerer, because the latter's efforts soon reveal glaring discrepancies between his claims and the anatomical



distribution of his nerve supply. The severity, extent and location of the pain and tenderness in intercostal neuralgia are extremely variable at different times and this variability has been assigned as additional evidence of the patient being a neurotic or semi-malingeringer. It has been my experience however that these variations as claimed by the individual patients are entirely consistent with the physical findings particularly from the anatomical standpoint. It is not unusual to see a patient's pain and tenderness entirely disappear as the result of two or more days of rest in bed and then recur shortly after getting out of bed. The spontaneous pain and the nerve trunk tenderness disappear before the nerve terminal tenderness in those cases in which the symptoms subside while under observation. Patients are commonly worse after physical activity but on the other hand I have occasionally seen mild localized symptoms become severe and widespread on confinement to bed due probably to a mattress or springs which caused harmful strain on the vertebral column. I have seen a patient in such severe

pain and exquisite tenderness from intercostal neuralgia despite large doses of morphine that he attempted suicide by jumping out of a sixth story hospital window in the evening and yet on the following morning his pain was entirely gone and his tenderness was barely demonstrable. An intercurrent toxæmia is prone to cause an exacerbation of symptoms in chronic intercostal neuralgia. All these variations in symptoms are due to the vagaries of the disease and are not to be regarded as evidence of the patient being a semi-malingeringer.

With all its numerous ramifications intercostal neuralgia is a rather complex disease or more often a symptom complex encountered in many different diseases but its signs and symptoms are so characteristic that the diagnosis can be made readily provided the examination of the patient is conducted along the proper lines.

The limits of this paper prevent my quoting from the literature citing illustrative cases and dealing with the treatment but I hope to write on these phases of intercostal neuralgia in the near future.

## THE INTRAVENOUS ADMINISTRATION OF MERCUROCHROME

BY HUGH H. TROUT, M.D., F.A.C.S., ROANOKE, VIRGINIA

BEFORE one enters into the discussion of the therapeutic value of any drug or chemical not only a study should be made of the article to be employed but more particularly consideration should be given to the manner in which the supposed beneficial effects are to be obtained.

Experiments with dyes were undertaken partly because of the failure of hexamethylenin (urotropin) to meet expectations as a urinary antiseptic. With the hope of making a compound of phenolsulphonaphthalein which would act as a genito urinary germicide Dr. Hugh H. Young began his experiments and as a result mercurochrome 220 was evolved after much research. In this work Dr. Young was assisted not only by his associates at the Brady Urological Institute but also by numerous chemists and bacteriologists.

There can be no question of the thoroughness with which this work was done nor can anyone knowing Dr. Young doubt for one moment his sincerity but we do have the right to question whether his enthusiasm has not allowed him to attribute to this dye beneficial effects which are perhaps not results but merely coincidences. I am sure with this in mind Dr. Young has made a very earnest and tremendous effort to obtain reports from numerous sources both as regards the bad as well as the good results and to those of you who are particularly interested in such a collection of cases you will find a most comprehensive report of 213 cases in the *Archives of Surgery* May 1935. In the same article there is a description of the dye its history and other interesting data.

In considering the manner in which the supposed beneficial results are obtained it is first necessary to outline one's conception of septicemia and this has been wonderfully done in a paper read before the American Surgical Association by Dr. Walter Martin and published in the September issue of *Annals of Surgery*. Naturally in the con-

sideration of this many sided problem, two questions promptly arise.

1 Does a blood stream infection spread in the same manner as does an infection in cellular tissue?

2 Is it possible to kill micro organisms with a dye or any other substance and at the same time not harm living cells?

In the answers to these questions will be found the justification or non justification for the continuation of intravenous medication.

It has been repeatedly demonstrated that if India ink, lamp black or any other inert substance be injected in the blood stream it will soon disappear from the peripheral circulation and may be found in localities in which the circulation is retarded as for instance in the capillary meswork of the spleen, the liver and the bone marrow. (The dye is not excreted by urine or bowel.) In these localities the dye is taken up by cells of the reticulo endothelial system. These cells are known to have great phagocytic power, as well as a reaction to certain vital stains. The relationship of these cells to antibody formation is most interestingly presented in an all too short article by Gay and Clark in the *Journal of the American Medical Association* October 25, 1924. Oppenheimer and Fishberg in the *Archives of Internal Medicine* November 1925 present a most instructive study of Leukemia and Reticulo Endothelial Apparatus. Martland, Conlon and Knief in the *Journal of the American Medical Association* December 5, 1925 demonstrate by means of an electroscope deposition of radio active elements in the phagocytic cells of the reticulo endothelial system in a paper the title of which is *Some Unrecognized Dangers in the Use and Handling of Radio-active Substances*. This however is neither the time nor the occasion for such speculation, further than the statement that it is my belief that the solution of any problem in intravenous medication and sterilization will be most intimately concerned with these very cells.

In this respect what is true as to the injection of dyes is also true as to the injection of bacteria into the blood stream. However, as a rule, we do not have a sudden injection of bacteria into the blood stream usually there is a slow leak of micro-organisms from some focus of infection so that the blood stream is thus afforded an opportunity to develop bactericidal substances with which to combat the toxins.

There are times when the peripheral circulation is free from bacteria while the spleen, liver, bone marrow, etc. may be full. In other words it is perfectly possible that peripheral blood cultures be negative at one examination and a few hours later show many colonies. In addition it is reasonable to assume that there are instances when the peripheral blood stream will show a fluctuation from numerous colonies to a negative culture for it is a generally accepted fact that bacteria are to be found in the peripheral stream in showers and between these "showers" no bacteria will be found. If such a hypothesis be true then one cannot with any great degree of certainty attribute the sterilization of the blood stream to any chemical unless we obtain a method of centrally examining also the blood in such organs as the spleen, liver, etc. Such examinations in the human being at least are of course, out of consideration and because of the difficulty of such examination in animal experimentation the results are also very uncertain and unsatisfactory.

Dr. George B. Lawson directed the following experiments which were carried out by the resident staff and laboratory personnel of the Jefferson Hospital, Roanoke, Virginia.

A series of four control rabbits of approximately the same size and weight received from 1 cubic centimeter to 1/10 cubic centimeter of a 24 hour culture of streptococcus hemolyticus. This particular culture of streptococcus hemolyticus was obtained from the University of Pennsylvania for in order to have the experiments uniform it was necessary to have some organism which would be constant in its power to produce fatal results. The injections were made into the posterior auricular vein and the animal died in from 6 to

48 hours. A similar series (4) injected with 1/100 cubic centimeter of whole heart serum obtained at autopsy and injected in the same region also died in the same period of time. All of the rabbits used in the entire experiment weighed from 3½ to 3 kilograms though of course rabbits of like size were taken for each corresponding experiment.

Four control rabbits received 7½ milligrams of mercurochrome per kilogram of body weight. They received no streptococci but died in an average of 72 hours.

In three series of four rabbits each 5 milligrams, 3 milligrams and 2.5 milligrams of mercurochrome per kilogram of body weight were given respectively in each series, but without streptococci. All lived.

In two series of four rabbits each two and later three intravenous injections of 3 and 2.5 milligrams of mercurochrome were given at 4 hour intervals. All lived.

Two rabbits each received 2.5 milligrams of mercurochrome and in addition each was given intravenously 1/100 of a cubic centimeter of whole heart serum obtained at autopsy from infected animals. Both succumbed in 12 to 24 hours.

Two rabbits receiving 3 milligrams of mercurochrome per kilogram with 1/100 of a cubic centimeter of infected serum died in from 12 to 24 hours.

Another series of two received the same amount of infected serum with few blood cells and 2.5 milligrams of mercurochrome per kilogram. The latter was repeated in 4 hours. The animals died in about the same length of time.

A similar experiment was conducted with 3 milligrams of mercurochrome per kilogram and the latter was repeated in 4 hours with the same result.

Again rabbits (two series of two each) were injected with the same amount of serum. This time the mercurochrome (2.5 and 3 milligrams respectively per kilogram) were given at the time of injection of serum as above and repeated both at 4 and 8 hour intervals but with a similar result.

Finally a series of eight rabbits was used. Six were given 1/100 cubic centimeter of 10

fectured serum Four of these as well as the two controls which had received no streptococci were given mercurochrome at  $\frac{1}{2}$  hour intervals over a period of 10 hours until 5 milligrams had been given per kilogram of body weight All of the rabbits receiving streptococci died within 24 hours Those receiving the mercurochrome alone, survived

From these experiments it may be concluded that doses of mercurochrome exceeding 5 milligrams per kilogram body weight were fatal to rabbits doses of 2.5 to 3 milligrams alone or repeated did not apparently affect the health of the animals

In virulent streptococcus infections mercurochrome whether given in massive doses or small repeated doses had little or no effect in checking or altering the course of the infection or in preventing its fatal termination However Dr Young reports in his clinical review of cases recovery in 9 out of 11 patients who had streptococcus haemolyticus septicaemia and who were given mercurochrome 220 This would certainly tend to discredit our work on animals in which the blood stream had been infected with the same organism

Because of the virulence of the streptococcus haemolyticus and the rapid spread and fatal termination of infection produced by it it was decided to duplicate as closely as possible the above work with organisms of lower virulence

A strain of staphylococcus aureus isolated from a blood stream infection in a child and a strain of bacillus coli isolated from human faeces were the organisms selected One, two and three cubic centimeters of a 16 hour broth culture of staphylococcus aureus were injected in three series of 3 rabbits each as in the preceding experiment These rabbits received no mercurochrome but the above amounts injected were not sufficient to cause death

A similar series was injected with bacillus coli with similar results

On account of the above results additional series were injected with 5 and 8 cubic centimeters respectively of the same aged culture of the staphylococcus aureus The results indicated that this organism was not of suffi-

cient virulence for further use and for this reason the bacillus coli was used to complete the experiment

By using 8 and 10 cubic centimeters of a 16 hour broth culture of bacillus coli with varying doses of mercurochrome as in the experiment with streptococcus haemolyticus, it was found that in single doses mercurochrome had no apparent effect in checking the progress of the condition

Repeated doses of 3 and 5 milligrams of mercurochrome per kilogram administered 4 hours after the injection of bacillus coli and the former repeated once 4 hours later seemed to indicate that this method of administration especially in 5 milligram doses was more efficacious than single doses in any of the amounts used

Fractional doses of mercurochrome at 30 minute intervals beginning 4 hours after the injection of bacillus coli and continuing for 10 hours were now given in 5 series of rabbits These animals received a total of 5, 7.5, 10, 15, and 20 milligrams respectively, over the 10 hour period

The results indicated that mercurochrome in this method of administration was more efficient in the larger doses than it was in what previously had been thought to be therapeutic doses for rabbits

To prove that the deaths were not due to a foreign protein reaction a rabbit considerably smaller ( $\frac{1}{6}$  kilogram) than those used in the balance of the experiment was injected with 8 cubic centimeters of sterile broth This rabbit showed no ill effects whatsoever and appeared absolutely normal on autopsy

From the second series of experiments it may be concluded that

- 1 Mercurochrome given in single doses of 2.5, 3 and 5 milligrams per kilogram, 4 hours after the production of a colon septicaemia in rabbits seemed to have little apparent effect in checking the progress of the condition

- 2 Mercurochrome given in 3 and 5 milligram doses per kilogram 4 hours after the production of a colon septicaemia, and the dose repeated at the end of 8 hours seemed to check the progress of the condition in that the rabbits appearing to be very sick, eventually recovered

3 When given at 15 hour intervals over a period of 10 hours mercurochrome seemed to check the progress of the condition especially in total doses of 15 to 20 milligrams per kilo gram body weight

It was now thought advisable to determine the effect of mercurochrome alone on various internal organs. We repeated some of the experimental work done by Dr Hugh H Young and arrived at very similar results

Rabbits were given intravenous injections of 2.5 5 7.5 10 15 20 25 and 30 milligrams per kilogram of body weight and sacrificed at the end of 24 hours. Their kidneys, livers and spleens were studied microscopically.

Following doses up to and including 7.5 milligrams per kilogram the only pathological finding was a cloudy swelling of renal epithelium and liver cells. This was variable and occasionally severe.

After the larger dosages the pathological changes were of the same character but very much more severe amounting to a coagulation necrosis. In the kidney these areas of necrosis were not confined to the cortex but frequently extended down into the medulla while in the liver the necrosis began in the region of the interlobular vessels and extended for a variable distance into the liver lobules. Mercurochrome staining of the tissues was observed after the larger doses.

When one considers that the ravages of syphilis are usually checked by the proper intravenous administration of some of the arsenic derivatives (neo arsphenamine) the course of malaria most frequently halted by the giving of quinine and perhaps the progress of pneumonia shortened by the use of optochin one should at least be encouraged in looking for some drug which when given intravenously might influence favorably blood stream infections. Of course neither the spirochætae of syphilis nor the plasmodium of malaria are true bacteria but their relationship is sufficiently close to give encouragement in this research work.

After all how a drug acts concerns the patient very slightly and frequently his physician less but what we want to know is does it obtain good results and I only wish the few cases in which we have tried mercuro-

chrome-220 could serve to give us the confidence in the beneficial effects of this dye we would like to have.

In the report by Drs Young Hill and Scott there are 213 cases from the various parts of the world many reading like miracles a few apparently complete failures. The report as a whole however gives one the impression that there must be some definite value to mercurochrome-220 for certainly the percentage of recoveries from different types of blood stream infections in desperately ill cases is very much higher than could be attributed merely to coincidence.

I will not bore you with a detailed account of our 14 cases further than to say that at least six of them recovered. In these cases we believe that mercurochrome 220 was of definite benefit. These six cases were as follows:

CASE 1. Septicæmia following tonsillitis and thrombosis of jugular vein. Streptococcus.

CASE 2. Puerperal septicæmia. Blood culture streptococcus diplococcus.

CASE 3. Puerperal septicæmia and pneumonia. Blood culture streptococcus. Pleurisy with effusion.

CASE 4. Gunshot wound of chest. Gram positive cocci, mostly diplococci.

CASE 5. Puerperal sepsis. Gram positive cocci tending toward diplococcus and streptococcus grouping. Probably non hemolytic streptococcus.

CASE 6. Multiple osteomyelitis. Small gram positive diplococcus.

Four out of the 14 patients died and in these mercurochrome 220 apparently had no effect on the progress of infection. These cases were as follows:

CASE 1. Gunshot wound with a streptococcus blood stream infection.

CASE 2. Spreading peritonitis following appendicitis. Blood culture streptococcus.

CASE 3. Multiple osteomyelitis and epiphysitis with negative blood culture.

CASE 4. Streptococcus infection following an abscess of tooth.

The remaining four cases we do not feel were influenced one way or the other by mercurochrome 220. They all however went on to recovery whether due to or in spite of mercurochrome. So I do not think anyone can state with any degree of accuracy.

All of our cases had some reaction. One patient had a slight gripping pain in the abdo-

men and one had twenty five bowel movements in one 24 hour period and many of these stools showed considerable blood. The last mentioned patient recovered. None of our cases was given over 5 milligrams of mercurochrome 220 to the kilogram of body weight. All 14 cases showed an increase in the amount of albuminuria and the number of casts after injections of mercurochrome 220.

Unfortunately there is no record in the hospital of the number of cases of blood stream infections which recovered without mercurochrome 220. This is due to the fact that until Dr. Young's report blood cultures were not generally made for up to that time no very definite attempt had been made toward blood stream sterilization.

There are three dangers to the intravenous use of mercurochrome 220. First and by far the greatest the overlooking in our zeal to try out the drug of something which should be done surgically such as the opening and draining of some secondary abscesses. This however should not be charged against the dye but is simply mentioned here because I have seen several such cases and this is unquestionably a distinct danger. Second the reaction following the intravenous administration of the dye. This might be sufficient to terminate the life of a patient already nearing an end though I have personally never seen a

case in which I thought this was true. It is probable that there are lesions produced in the liver and other viscera by mercurochrome 220 in addition to those due to the infection, which are permanent and detrimental to the future health of the patient. Third, and this too should not be added to the debit side of mercurochrome 220 the indiscriminate giving of the dye by physicians who are not in position to obtain blood cultures etc. Certainly all intravenous medication has great potential dangers and should not be given except in well equipped hospitals.

Extremes are always dangerous and the middle ground is usually safe, and such I believe should be our attitude toward the giving of mercurochrome 220 intravenously.

Finally, if I were asked to give my own personal view briefly, I would state

Given a patient with a positive blood stream infection in whom all possible foci had been removed mercurochrome is worth a trial. At least it gives us one more thing to do in these otherwise hopeless cases and even if it is of no benefit to the patient this will often prove of some comfort to the family. I do not believe however that all the claims made for it as a blood stream sterilizer are as yet proved and mercurochrome like any other substance should not be put in a vein unadvisedly or lightly.

ACUTE INTESTINAL OBSTRUCTION DUE TO MALIGNANCY<sup>1</sup>

By FRED W. RANKIN, M.D., F.A.C.S., LEXINGTON, KENTUCKY

**A**CUTE intestinal obstruction superimposed upon malignancy represents a dual condition both factors of which are potentially lethal. The statistics of a large series of cases of acute obstruction from all causes will show that carcinoma of the colon is second to carcinoma of the stomach in incidence in intra abdominal malignancy and is the etiologic factor in acute intestinal obstruction in a very large percentage of cases. Better borne clinically than an acute obstruction in the small intestine because of the less rapid production of acute chemical intoxication resulting from absorption of toxins produced in the obstructed bowel loop, acute colonic obstruction is usually less fulminating in its manifestations, and consequently later diagnosed.

Burgess analyzed all cases of acute intestinal obstruction admitted to the Manchester Royal Infirmary over a period of 10 years. In a total of 66,373 surgical admissions he found 1,278 cases of intestinal obstruction including large and small intestine cases. In a total of 485 cases of malignant growth of the large intestine he found 173 cases of acute intestinal obstruction. This series with that of Corner, who reviewed the cases of malignant obstruction admitted to St. Thomas Hospital over a period of 11 years and that of Miller who reviewed 129 cases of cancer of the colon, 25 of which were admitted to the hospital for acute intestinal obstruction is the largest series recorded but numerous smaller groups of cases show a corresponding percentage of incidence, location of growth and extent of disease found at operation. Burgess analysis showed that his colonic group represented 35.6 per cent of 485 cases of malignant growth of the large intestine and that in the cases of intussusception the colon was concerned in 364 cases (28 per cent of the group) while excluding intussusception, the colon was involved in 199 cases, 17.8 per cent. I quote Burgess

paper: 'We may say that if in any given case of acute intestinal obstruction we can locate the site of the obstruction to the colon and can also exclude strangulated external hernia and intussusception as the cause then there remains a 91.04 per cent chance of the condition being due to a malignant growth, or roughly a 9 to 1 chance.' His series showed that acute obstruction occurred in the right colon in 13 per cent and in the left colon in 87 per cent.

With the exception of the rectum the sigmoid flexure is the most frequent site of cancer in the large bowel. With about one third of the colonic malignancies occurring in this segment approximately one half of the acute obstructions are found in this location. The cæcum shows an incidence second to the sigmoid in location of growths but is far less frequently the site of obstruction (6.3 per cent). This is due to several factors. The growths of the right colon are cellular, soft given to ulceration and produce symptoms of anemia, intoxication and dehydration from absorption and loss of blood rather than from obstruction. Intussusception occurs frequently in this segment and occasionally volvulus associated with malignancy produces an acute obstruction. When the latter condition occurs invariably there is an abnormally long mesentery to the right colon which is continuous with that of the small bowel furnishing the necessary mechanical factors for twisting.

Colloid carcinoma occurs frequently in the right segment of the colon, 22 per cent of Parham's 72 cases in which the cæcum and ascending colon were involved being of this variety. The transverse colon which is second to the sigmoid as a site of acute obstruction showed 7 per cent of 165 cases of the colloid variety while the sigmoid showed only 4 per cent of 138 cases.

Sarcoma of the ileocecal coil occasionally is the underlying factor in an acute right sided colonic obstruction. I reported last

year a case of ileocecal sarcoma producing acute obstruction by intussusception upon which I operated as an emergency under the impression that the pathological condition was due to an appendiceal abscess. Resection of the ileocecal coil was followed by operative recovery but a recurrence was noted at the end of 6 months.

The mechanical obstruction produced by carcinoma differs from that produced by sarcoma. Sarcoma arising in the lymph follicles of the bowel extends into the mucosa and other coats except the peritoneal covering by a progressive growth which is rarely perforative. Ulceration of the mucosa takes place late although it occurs in a relatively high percentage of cases. The bowel proximal to the tumor is dilated because of the paralysis of the musculature from the direct invasion of the malignancy, and this dilatation rather than stenosis produces an intermittent obstruction which gradually becomes complete from external pressure. The reverse is true in carcinomatous invasion the stenosis being produced by direct contraction of the bowel lumen from the signet ring type of growth. One in four carcinomata of the colon are of the annular variety encircling the bowel lumen. The high incidence of obstruction in the left colon is due to three factors (a) the type of pathological growth (b) the character of the normal physiological content of the distal colon and (c) the more constant fixity of the various divisions and the greater number of angulations which normally occur at the rectosigmoid junction the junction of the sigmoid with the descending colon and at the splenic flexure. Normally there is a narrowing of the bowel lumen at these points which are held more or less rigid or semi rigid by the close fixation to the abdominal parietes. A sharp angulation is the rule at the splenic flexure and at the other points mentioned the mobility of the bowel above and below tends to increase the probability of obstruction. The content of the left colon is normally formed and hardened faeces while that of the right half around to the middle of the transverse segment is liquid or semi solid and easily passed by stenosis of considerable degree. The pathological characteristics of

growths in the two segments differ widely although adenocarcinoma is present in all colonic cancers. The encircling constricting annular variety occurs almost entirely distal to the transverse segment.

Two varieties of acute obstruction occur one coming on unheralded out of a clear sky in 5 per cent of the cases according to Miller's statistics. The other which occurs in the larger group of cases represents the extension of the chronic process into a subacute obstruction and finally an acute complete stenosis. In the first variety premonitory symptoms are unusual and the attack is ushered in by fulminating symptoms demanding immediate relief. The second variety usually gives a history of several weeks of indefinite symptoms prior to the development of acute obstruction. Several rather acute attacks may have been passed through relief being obtained by the use of enemata and purgation. This indicates that a slow stenosis is taking place which gradually becomes subacute because the bowel contents cannot pass beyond the constriction with the result that traumatism to the mucosa has set up in an inflammatory reaction which causes a complete blocking.

The 4 cases of acute malignant obstruction which have come under my observation in the past 18 months and which I am presenting have been the result in 3 instances of carcinoma and in 1 instance of sarcoma. All represent malignancy of different segments of the colon and in each instance a different operative procedure was instituted. The 3 patients were young being 27, 30, and 31 years of age respectively. 1 patient was a woman of 60. The location of the growth was in the splenic flexure in one instance at the junction of the descending colon with the sigmoid in another in the central portion of the sigmoid in the third, and in the ileocecal coil in the sarcoma case. All patients were suffering from acute obstruction on admission. Of the 3 cases of carcinoma, 1 represented an unheralded type of obstruction while 2 were typical of subacute stenosis suddenly becoming acute. In the sarcoma case the obstruction was an acute one due to intussusception. Three of the 4 made oper-



ative recovery and died from peritonitis following enterostomy

**Case 1** Russell Ishmael, age 27 male white married. A diagnosis was made of carcinoma of the descending colon and acute intestinal obstruction. The complaint was pain in the stomach with nausea and vomiting. The family history was unimportant, the father and mother 1 brother and 3 sisters were living and well. One brother died as a result of lockjaw. The personal history prior to the present illness was negative except for the diseases of childhood which he had without complication.

**Present illness.** The patient was admitted to the hospital on July 20 1925 with an acute abdominal condition which had been present for 48 hours, but which on careful questioning was found to have existed in a subacute manner for 10 days. Since July 8 the patient had been unable to work because of frequent and severe cramping pains in the abdomen. His appetite was good he ate three meals per day during this time and there seemed to be no relation between the food and the pain. He was able to sleep at night and had not been awakened by abdominal distress. The paroxysms had never exceeded 3 or 4 during the day. Forty eight hours prior to admission to the hospital after a meal at 6 p. m. pain became very severe with nausea and vomiting. This gave some relief but at frequent intervals the paroxysms of pain returned. During the past day he had been in almost constant pain and the abdomen had become distended and uncomfortable. Nausea and vomiting had been frequent.

The past history was negative for abdominal symptoms with the exception of one attack of pain accompanied by nausea and vomiting 6 years ago. This attack had not recurred and he knew of no reasonable explanation for it. The patient had always been constipated and more so recently. The histories of the genito urinary and cardiovascular systems were negative.

**Physical examination.** The patient was young and well nourished evidently in acute pain. General examination was negative except for the abdomen. There was marked distention throughout the entire abdomen with considerable muscular rigidity. Tenderness was elicited in epigastrium and right hypochondrium. No palpable mass was made out. The temperature was 99.2 degrees F. pulse 78 respiration 20 blood pressure 120/80. Because of the patient's muscular development no peristaltic movement could be made out in the abdomen. The blood count showed a high leucocyte count 22,800 with polymorphonuclears 86 per cent. The urine was high in specific gravity 1035 showed a trace of albumin and a large quantity of indican. Microscopic examination was negative.

Operation was undertaken immediately. Through a right rectus incision the abdomen was opened and free fluid blood tinged in character was found. The small intestine which presented at the operative

wound was markedly distended the ileocecal valve was sought and it was found that the right colon was filled with gas. Exploration revealed an anular carcinoma of the descending colon which was producing complete obstruction. Because of the distention in the small bowel it was thought wise to do an enterostomy instead of a caecostomy. This was done and a large quantity of fluid intestinal contents were drained out. The patient developed a peritonitis after operation and died on the fourth day.

Autopsy showed the carcinoma in the descending colon close to the sigmoid flexure to be completely obstructing. There was metastasis to the regional lymphatic glands but not to the other abdominal organs. Death was due to peritonitis.

This case represents a type of subacute obstruction which developed into an acute complete obstruction. At the time of admission to the hospital the large bowel was completely shut off and the question of relieving the complete obstruction was the paramount one. The type of operative procedure undertaken was I believe a satisfactory one from the standpoint of judgment but a break in technique in doing an enterostomy may account for the peritonitis.

This case illustrates the possibility of backward pressure in the colon under acute obstructive conditions when a way is forced through the ileocecal valve after a length of time. Normally the valve mechanism is made tighter by increased colonic pressure because the mucous membrane pouts into the caecum and because the consequent constriction of this portion of the ileum with edema and infiltration makes a plug under obstructive conditions. Evidently the plug gives way and the liquid content of the right colon is forced back into the small bowel.

Obviously considerable intracolonic pressure is required in those cases in which anatomical relations of the ileocecal valve are such as those just described. Often the valve is a mere opening without protrusion of mucosa into the large bowel and no doubt slight pressure from the distal arm will cause a relaxation of the muscle fibers and consequent dilatation of the small bowel.

Enterostomy I believe might be accomplished more satisfactorily in many of these cases by dividing the terminal ileum several inches from the valve and putting a tube into each end of the cut bowel forcing the distal

end into the cæcum through the valve much after the manner of Brown's ileostomy used for ulcerative colitis. Anyone who has attempted to put a tube into a hugely distended cæcum which has been obstructed for some time has had the experience of finding the needle holes leak bowel content and the oedematous wet cæcal wall cut through by suture with such ease that it is impossible to make a proper closure and peritonitis is liable to ensue. The thick heavy small bowel wall however may be handled with much more facility and rarely I believe will this occur.

CASE 2. Mrs W. H. age 30 female white married was a housewife. The family history showed the father and mother living and well, no brothers and no sisters. She had been married 7 years and had 3 children the youngest being 2 years of age. Menstruation began at 13 years of age, had been regular every 4 weeks from 4 to 5 days in duration with moderate pain and normal amount of flow. The past history except for childhood diseases was negative. There had been no former operations.

Present illness. Five days ago the patient developed suddenly symptoms of acute intestinal obstruction. She was seized with pain in the lower abdomen soon radiating throughout the whole abdomen and accompanied by nausea and vomiting. The bowels were not moved either by enemata or cathartics. She continued to pass gas however until 48 hours ago. Tenderness and rigidity of the abdomen increased, but there was even on admission to the hospital only slight distention. Subsequent to operation no history of constipation or intestinal attacks could be elicited other than that she had had occasional mild attacks of indefinite abdominal symptoms referable to the stomach and relieved by home remedies.

Except for the abdomen the general physical examination was negative. The abdomen was slightly distended and symmetrical. There was moderate tenderness and muscular rigidity in all quadrants. On percussion uniform tympany was noted. There was an indefinite mass in lower quadrant apparently more in right side than in left.

Operation was performed immediately August 10, 1925. Through a low incision the abdomen was opened and the colon was found to be distended throughout its entire length above a mass in the middle of the sigmoid flexure. The palpable mass made out prior to operation was a distended and loaded right colon. The obstruction was due to a malignancy encircling the bowel and completely stenosing it. The type of cancer was the signet ring variety and the growth occupied about 2 inches of the bowel wall. There were no demonstrable metastases. The growth was brought out through the incision as a Mikulicz Bruns procedure and the abdomen closed. Thirty hours subsequently a

cautery hole was made in the proximal loop of bowel and a catheter inserted. This relieved the gas distention immediately and the progress from this point on was uneventful. Six days later August 16 the second stage of the operation was completed and with cautery the tumor mass was severed.

The pathological diagnosis was adenocarcinoma.

The patient returned to her home in an adjoining state to wait for 3 months before having the colostomy closed.

Despite the favorable operative recovery in this case I deprecate the type of technical maneuver instituted. The operations of enteronization have, I think, a very limited field of usefulness in malignancy, and in acute obstruction due to malignancy I feel that their employment is distinctly contra-indicated. Such a procedure accomplishes nothing toward the allaying of the symptoms and toxæmia in an acute obstruction which is the paramount issue in an emergency. To perform a Mikulicz Bruns operation in acute obstruction is but to multiply the hazards in an already desperate case. It is possible that this type of procedure may occasionally be advantageously employed as a supplement to a caecostomy, but even here I believe its employment is distinctly limited. It is a temptation always to bring out a loop of bowel which shows a cancer when it is freely movable and may be excised later without invading the peritoneal cavity, but this temptation may be readily overcome by study of mortality statistics which prove that the supposed low death rate incident to this type of procedure is in error as regards immediate operative recovery, while the end results are influenced in a markedly unfavorable manner by its institution.

CASE 3. Mrs J. C. B. S. age 60 female white married was a housewife. Her mother died of skin cancer at 75, the father died of senility at 79, a maternal uncle died of cancer. The patient had been married 36 years and had 2 children aged 35 and 32, there had been no miscarriages. The menopause occurred 12 years ago. The past history was unimportant except for typhoid fever and repeated attacks of tonsillitis. For several years she had had shortness of breath on exertion and occasional attacks of cardiac discomfort associated with weakness and dizziness. The complaint was general abdominal pain and intermittent vomiting for 6 weeks.

Present illness. For 6 weeks the patient had been more or less subacutely ill, suffering with paroxysms

of abdominal pain accompanied by nausea and vomiting coming on 4 or 5 times daily. The first attack was ushered in with severe pain in the epigastrium never by nausea or vomiting. The pain was sharp and gripping in character and intermittent and the patient thought she could see a tumor in her upper abdomen during the attack. Her bowels which had long been chronically constipated became obstinately constipated but were relieved by enemata. Never at any time did she notice any blood in the stool or on the stool. These abdominal attacks had increased in severity and for the past 20 days she had been confined to bed suffering considerable pain and without a bowel movement despite purgation. She had grown weak and toxic from loss of fluids and had lost 15 pounds in weight during this period. The character of the vomitus had never been fecal and had never contained blood although the odor was offensive.

Physical examination showed an emaciated, acutely ill, elderly lady with drawn face, anxious expression and flushed cheeks. The abdomen was hugely distended and a tumor mass occupying the epigastrium and right hypochondrium and extending down to the crest of the ilium was visible. The abdominal musculature was poor and observation of the tumor readily disclosed peristaltic waves. Palpation showed the tumor to disappear under the left costal margin and traced it across the upper abdomen and down into the right iliac fossa. The tumor was doughy in feel and evidently contained large quantities of gas and fluid since gurgling was made out readily on movement. Over its entire extent the tumor was hyperresonant. Blood pressure was 110/90, pulse 100, temperature 98. The heart sounds were low pitched and weak and otherwise the physical examination was negative. The urine was acid in reaction, albumin one plus, sugar one plus, specific gravity 1.002. Blood hemoglobin 70 per cent, erythrocytes 4,000,000, leucocytes 5,700.

Operation was performed September 9, 1925. A high left rectus incision disclosed the transverse colon and cecum hugely dilated, forming the palpable mass. An annular carcinoma high under the costal margin of the splenic flexure was palpated. Through a separate McBurney incision a caecostomy was done. It was noted at operation that the cecum was thick and edematous and that the semi-fluid content about half filled it while the remainder of the distention was due to gas. A large rubber tube about the size of the index finger was used in making the caecostomy. The patient reacted well, did not vomit again and made an uninterrupted recovery, gaining in strength and weight. The tube drained satisfactorily and was used to irrigate the caecum daily after first 72 hours.

Secondary operation was done September 24, 1925. The abdomen was opened through the same left rectus incision as that used for exploration. The splenic flexure was mobilized and resected and end to end anastomosis was made between the

transverse colon and the descending arm. The Parker-Kerr aseptic basting stitch method was used satisfactorily and the anastomosis completed without difficulty. The patient made a good recovery from the operation and was dismissed from the hospital at the end of another 2 weeks.

This type of operation in two stages perhaps represents the most satisfactory method of dealing with these acute obstructions of the colon. A justifiable criticism may perhaps be leveled at the surgeon for even exploring a weakened and devitalized patient suffering from malignant obstruction. Bevin and others have pointed out the advisability of merely relieving the immediate obstruction by a rapid caecostomy done under local or gas anaesthesia through a McBurney incision and later carrying out the necessary examination to ascertain the underlying cause which may be dealt with as circumstances permit. The changes in the local condition of the bowel at the secondary operation are impressive and the lack of edema and infiltration plus the general improvement in the physical condition emphasize the advantages of a graded procedure. In this particular location in the splenic flexure obstruction in either acute or chronic form is present in practically every case of carcinoma.

#### TREATMENT

The treatment of acute intestinal obstruction due to malignancy resolves itself into immediate relief of the obstructed bowel rather than technical maneuvers designed to deal with the underlying malignancy. The high mortality of obstruction is recognized as being a mortality of delay and as Van Beuren puts it, "The longer the patient with bowel obstruction lives before operation the sooner he dies after operation." Except in the 5 per cent of fulminating cases and in the acute cases due to volvulus, intussusception and strangulated hernia, diagnosis is more apt to be delayed in cases of colonic tenosis than in cases of small bowel obstruction. The time at which diagnosis is made influences the type of operation undertaken and the resulting mortality. The obvious diagnosis of strangulated hernia accounts for the difference in its favor in mortality when

compared with other forms of acute intestinal obstruction. It is unessential to know the exact cause of acute intestinal obstruction before instituting treatment especially if the obstruction is of any length of standing. Even after the diagnosis of acute obstruction is arrived at occasionally it is not apparent whether the obstruction is in the ileum or in the large bowel and even if obstruction is present whether exploration should be made.

Physical examination of the distended abdomen plus a careful history usually indicates the type nature and location of the obstruction. If the ileocecal valve remains competent and does not permit back flow of the intestinal content into the small bowel usually tumefaction peristalsis and outline of the colon indicates the position of the stenosis.

In 2 of our cases the tumor was entirely in the right side and on examination was found to be in the cæcum and ascending colon while the obstruction was located in 1 case at the splenic flexure and in another at the junction of the descending colon with the sigmoid. As Mr Burgess aptly remarks:

The keynote to the diagnosis is the condition of the cæcum: if it is visibly distended or failing this if it can be definitely felt to alternately soften and harden under the examining finger then the obstruction is distal to it.

When the abdomen is opened the condition of the ileocecal coil indicates the location of the obstruction. Whether or not exploration or simple drainage should be undertaken I believe can be answered by the individualization of cases and institution of exploration in those whose general condition seems to warrant it. Mortality statistics indicate clearly that major operative procedures are distinctly contra indicated. Primary resection in the face of acute obstruction has an excessively high mortality, and is not to be considered favorably in the treatment of this condition. An 85 per cent mortality in resection of the colon for acute obstruction due to malignancy (exclusive of the ileocecal coil) regardless of the type of technique employed, is prohibitive. Enterocolostomy, colostomy, and enterostomy are types of operation to

be considered with or without exploration. Apparently cæcostomy alone without exploration is the operation of choice in the majority of instances. A blind cæcostomy may result in a volvulus or internal strangulation being overlooked in a small percentage of cases but Burgess assumes that the increased mortality from overlooked gangrenous intestine is only 15 per cent. Cæcostomy has advantages over the other types of operation both as an emergency measure and as a primary step of a graded operation even in chronically obstructed cases. It permits drainage of the bowel and at the same time may be used as an avenue of medication to reduce the local inflammatory conditions against the time of subsequent resection. It is placed further from the field of secondary operation than is colostomy and usually requires little or no effort to close after the secondary resection has been carried out.

The Gibson technique we have found satisfactory both because it can be used in emergencies and because it usually closes spontaneously or by a minor maneuver. Through a split muscle incision under local anesthesia or local and gas the cæcum may be rapidly delivered, a large tube placed in it and immediately siphonage into a bottle at the bedside is commenced.

In acute obstruction of the colon the mortality is more than 30 per cent from a simple maneuver alone and the percentage rises in direct ratio to the increase in magnitude of the operative procedure and the delay in diagnosis. The acute crisis being past roentgenography indicates the location of the growth and its extirpation may be undertaken safely at a second stage when the general and local conditions have been improved.

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of abdominal pain accompanied by nausea and vomiting coming on 4 or 5 times daily. The first attack was ushered in with severe pain in the epigastrium never by nausea or vomiting. The pain was sharp and gripping in character and intermittent and the patient thought she could see a tumor in her upper abdomen during the attack. Her bowels which had long been chronically constipated became obstinately constipated but were relieved by enemata. Never at any time did she notice any blood in the stool or on the stool. These abdominal attacks had increased in severity and for the past 10 days she had been confined to bed suffering considerable pain and without a bowel movement despite purgation. She had grown weak and toxic from loss of fluids and had lost 15 pounds in weight during this period. The character of the vomitus had never been fecal and had never contained blood although the odor was offensive.

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justifiable in view of this fact and of the extremely radical position adopted in general surgery toward cancer? Does it seem logical to expect results from a partial operation in which only an apparently normal rim of tissue 0.5 centimeters wide separates the surgeon's knife from the disease? I say apparently, since the cases cited in a former paper show how fallacious may be our preoperative judgment on this point.

The diagnosis should be made on the history appearance and the situation of the growth and on the exclusion of syphilis and tuberculosis. Biopsy is robbing us of our powers of observation and is as open to criticism here as it is in general surgery where it is resorted to only in exceptional circumstances. I have been forced to employ it in only a few instances in 122 cases.

The extent of the growth should not be estimated on the image seen by direct or indirect laryngoscopy since the upper edge is all that appears for inspection. It would seem quite safe to add two thirds to what is visible in forming a mental picture of its size.

Formerly when in doubt as to the extent of the disease I advocated opening the larynx for better orientation. I now believe that this should be avoided since the incision may bisect the growth and disseminate it. Furthermore this procedure may let blood into the trachea and if it must be followed by a total laryngectomy the time consumed adds materially to an already serious and dangerous operation. If doubt exists in the operator's mind the patient should be given the benefit of that doubt by having the more radical operation done.

It is my conviction that only the most incipient cancers should be treated by any method other than the most radical and we must always bear in mind that we have but one operative chance to cure the disease. Secondary operations have at least in my hands been a failure.

#### OPERATIVE PERIOD AND TECHNIQUE

The surgical period may be divided into three stages (1) the preparation, (2) the operation (3) the after treatment.

1 *The preparation* The 2 deaths noted in the above series were due to faulty metabolism. One patient was an obvious diabetic the other gave a history of glycosuria for a short period 2 years prior to consulting me. After operation the tissue reaction suggested diabetes, and this was confirmed by the finding of a high percentage of sugar in the blood. The lesson learned from this experience leads to the first point in the period of preparation. A metabolist determines the patient's chemical status and if the metabolism is faulty he makes an effort to rectify it. If a metabolic balance cannot be established especially if the blood sugar cannot be brought to a safe limit operation is refused.

Cardiovascular degeneration if not too advanced does not contra indicate operation. The exhibition of digitalis may be of great value and if employed should be completed just before the operation. Special attention is paid to the condition of the digestive tract and particularly the colon. During the week preceding the operation three colon irrigations are given at two day intervals. The first one is preceded by castor oil. This should be thoroughly done so that the patient arrives at the operation with a clean colon. During this week a diet low in protein (excluding eggs and sweet milk) is advocated.

All carious and pyorrhœal teeth are extracted and the remaining ones cleaned. Entire absence of teeth augments the prospect of primary union or at least of lesser degree of infection. Morphine grain  $\frac{1}{4}$  and atropine grain  $\frac{1}{200}$  are given hypodermically 1 hour before the operation.

2 *The operation* A combination of local and general anesthesia is in my opinion better than one of these alone. By this method the duration of the general anesthesia is reduced to one half hour, an important factor in the resistance of the patient.

If the growth encroaches upon the breath way the administration of general anesthesia from the start may increase the embarrassment and necessitate a tracheal opening before the surgeon is ready. If the patient becomes cyanosed and is not promptly relieved the consequent lung hyperæmia

LARYNGECTOMY IN ONE STAGE<sup>1</sup>

BY J. E. MACKENTY, M.D., F.A.C.S., NEW YORK CITY

SINCE 1908 about 395 cases of laryngeal cancer have come under my observation 123 of which have been subjected to surgical treatment as follows: thyrotomy or laryngofissure 22 no deaths 15 recurrences 7 cures hemilaryngectomy 6 no deaths 4 recurrences, 2 cures, total laryngectomy 95 2 deaths 15 recurrences.

In 2 other cases in which death resulted from embolus and meningitis 3 and 8 weeks after operation the history is debatable. These cases are fully discussed elsewhere.

All deaths were in diabetics and syphilitic diabetics. There were none in patients with normal blood chemistry. It is most encouraging that in 57 frankly intrinsic cases there have been only 2 recurrences after total laryngectomy. The large recurrence in thyrotomy was due to faulty selection of operation and occurred in the cases treated between 7 and 12 years ago.

Hemilaryngectomy is an unjustifiable operation. Total laryngectomy has been gaining in favor over thyrotomy in recent years.

Operators are divided on the question of the best method for total laryngectomy between the one stage operation on one hand and the various multiple stage operations on the other. The merits of these methods cannot be discussed here. Personally I have always liked the one stage operation and feel that the results obtained justify this position.

I shall enumerate the principles governing the one stage operation.

The surgical principles involved are the following:

1. A careful study of the patient's general condition and of the metabolism especially as shown in the blood chemistry. Patients with pronounced and irremediable metabolic imbalance are rejected.

2. Digitalization just prior to the operation in all cases in which cardiovascular degeneration is suspected.

3. Careful dieting and colonic lavage for at least one week preceding the operation.

4. Mouth hygiene. All diseased teeth are extracted and diseased gums treated. Practically all mouths are unclean at the age when cancer occurs. The entire absence of teeth is a distinct advantage.

5. The combination of local and general anesthesia the latter not to exceed one half hour in time.

6. The absolute exclusion of blood from the trachea during operation and of wound drainage after operation.

7. The placement of wound drainage so as to block off extension of the infection into the planes of the neck and the special management of this drainage during the convalescent period.

8. The anchoring of the trachea in the lower angle of the wound and the corking of the trachea to exclude wound drainage during the entire convalescent period.

9. The use of suction for wound cleansing and for clearing the trachea of secretion. Inspissated secretions sometimes lodge at the tracheal bifurcation causing serious embarrassment to respiration. These should be removed with the bronchoscope.

10. The use of the naso-oesophageal feeding tube extending only half way down the oesophagus. This insures a liberal diet from the start.

11. After care. The dressing and care of the wound should be done by the surgeon himself and not by an assistant or staff doctor probably untrained in this work. All one's experience in the handling of infected wounds is required in forestalling a serious septic invasion.

I would call especial attention to the high percentage of recurrence in all but total laryngectomies and to the recurrence of the disease in all the extrinsic and in many of the late apparently intrinsic cases. The great majority of laryngeal cancers are squamous celled and extremely malignant. Is the present conservative attitude toward laryngology

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justifiable in view of this fact and of the extremely radical position adopted in general surgery toward cancer? Does it seem logical to expect results from a partial operation in which only an apparently normal rim of tissue 0.5 centimeters wide separates the surgeon's knife from the disease? I say apparently since the cases cited in a former paper show how fallacious may be our preoperative judgment on this point.

The diagnosis should be made on the history, appearance and the situation of the growth and on the exclusion of syphilis and tuberculosis. Biopsy is robbing us of our powers of observation and is as open to criticism here as it is in general surgery where it is resorted to only in exceptional circumstances. I have been forced to employ it in only a few instances in 122 cases.

The extent of the growth should not be estimated on the image seen by direct or indirect laryngoscopy since the upper edge is all that appears for inspection. It would seem quite safe to add two thirds to what is visible in forming a mental picture of its size.

Formerly when in doubt as to the extent of the disease I advocated opening the larynx for better orientation. I now believe that this should be avoided since the incision may bisect the growth and disseminate it. Further more this procedure may let blood into the trachea and if it must be followed by a total laryngectomy the time consumed adds materially to an already serious and dangerous operation. If doubt exists in the operator's mind the patient should be given the benefit of that doubt by having the more radical operation done.

It is my conviction that only the most incipient cancers should be treated by any method other than the most radical and we must always bear in mind that we have but one operative chance to cure the disease. Secondary operations have at least in my hands been a failure.

#### OPERATIVE PERIOD AND TECHNIQUE

The surgical period may be divided into three stages: (1) the preparation, (2) the operation, (3) the after treatment.

1 *The preparation.* The 2 deaths noted in the above series were due to faulty metabolism. One patient was an obvious diabetic the other gave a history of glycosuria for a short period 2 years prior to consulting me. After operation the tissue reaction suggested diabetes and this was confirmed by the finding of a high percentage of sugar in the blood. The lesson learned from this experience leads to the first point in the period of preparation. A metabolist determines the patient's chemical status and if the metabolism is faulty, he makes an effort to rectify it. If a metabolic balance cannot be established especially if the blood sugar cannot be brought to a safe limit operation is refused.

Cardiovascular degeneration if not too advanced does not contraindicate operation. The exhibition of digitalis may be of great value and if employed should be completed just before the operation. Special attention is paid to the condition of the digestive tract and particularly the colon. During the week preceding the operation three colon irrigations are given at two day intervals. The first one is preceded by castor oil. This should be thoroughly done so that the patient arrives at the operation with a clean colon. During this week a diet low in protein (excluding eggs and sweet milk) is advocated.

All carious and pyorrhœal teeth are extracted and the remaining ones cleaned. Entire absence of teeth augments the prospect of primary union or at least of lesser degree of infection. Morphine grain  $\frac{1}{4}$  and atropine grain  $\frac{1}{200}$  are given hypodermically 1 hour before the operation.

2 *The operation.* A combination of local and general anesthesia is in my opinion better than one of these alone. By this method the duration of the general anesthesia is reduced to one half hour an important factor in the resistance of the patient.

If the growth encroaches upon the breathway the administration of general anesthesia from the start may increase the embarrassment and necessitate a tracheal opening before the surgeon is ready. If the patient becomes cyanosed and is not promptly relieved, the consequent lung hyperæmia



may predispose to a postoperative pneumonia. Hence the advantage of leaving bare the larynx and the first and second tracheal rings under local anesthesia before a general anesthetic is given. One per cent novocain is used for the preliminary anesthesia one fourth to one half of 1 per cent for the deeper structures during the operation. To this is added a very minute amount of adrenalin (10 drops).

The T incision is used. The dissection is carried backward until the larynx and trachea are skeletonized. When hæmostasis is complete and all vessels tied, the patient is given a general anesthetic. The trachea is now cut across just below the cricoid or lower if need be, minute care being taken that no blood enters the lumen of the tube. It is an advantage to inject a few drops of a 10 per cent cocaine solution between two rings into the trachea before dividing it. This allays cough. The larynx is lifted forward and the posterior wall of the trachea is incised down to the œsophageal wall. A rubber tube which fits snugly into the tracheal lumen is inserted into the trachea to a depth of about two inches. This acts as a tracheal extension, turns back the blood and enables the anesthetist to continue without being in the way.

The larynx is separated from the œsophagus from below upward to a point behind the arytenoids. It is then allowed to fall back into position and the thyrohyoid membrane is divided so that it opens into the hypopharynx just below the attachment of the epiglottis. Before this is done the anesthetist or an assistant opens the mouth, sucks out all the secretion and paints the entire cavity, the pharynx and the hypopharynx with a 1:200 solution of acrifiolet. The nasal cavity is similarly treated. The edges of the opening in the thyrohyoid membrane are grasped and held apart. A yard of folded gauze 2 inches wide is stuffed into the hypopharynx and packed upward until it fills the hypopharynx, pharynx and mouth. At this point a careful inspection is made of the growth. If it is found to be entirely intracavitary the larynx is removed by cutting as close as possible to the superior border of the thyroid cartilage. The opening thus made in the

hypopharynx is small and lends itself better to successful repair. If the disease has approached the top of the laryngeal box or has involved the arytenoid, then more tissue is sacrificed even to the removal of the anterior hypopharyngeal wall adherent to the posterior surface of the larynx. In several cases 1 to 1½ inches of the anterior part of this wall have been taken away with the larynx without producing subsequent stricture.

Just before the last stitch is tied in the closure of the hypopharynx the anesthetist removes the gauze packing through the mouth. The pharynx and mouth are again cleansed by suction and painted with a solution of mercurochrome (2 per cent). A feeding tube of a size which will pass through the nose without undue pressure is introduced through the more open side. When its point appears in the œsophagus beneath the untied stitch, the surgeon directs it into the œsophagus to a depth of 6 or 8 inches. The point of exit from the nose is now carefully marked and the tube secured to the face.

The last stitch is now tied. If the redundancy of the tissue permits a second layer of stitches is placed over the first in the hypopharyngeal closure. No plain gut is used.

The trachea is anchored to the skin of the neck by two or three mattress sutures each passed around a ring and brought out about 1 inch or more from the edge of the wound. These are tied on small perforated lead discs. This steadies the tracheal stump in the wound and relieves the strain upon the stitches which are to unite the skin edges with the mucous membrane of the trachea. This may be omitted if the trachea stands high in the wound. These stitches must be removed on the third day. To make this union more exact the fat under the skin at the wound edges is cut away. This allows the skin to fall more easily into relationship with the rim of the tracheal stump. The skin strip and rim of the trachea are united by interrupted sutures, fine silk or better fine equisetene being used. The wound is loosely closed, no effort being made to bring the deeper parts into anatomical order. It is essential to get a primary union at one point—that is where the two lines of the T cross.

I have observed that if the integrity of this part of the wound can be maintained the subsequent healing is much more rapid and a hypopharyngeal fistula does not form. If a break occurs at this point or if the wound has to be entirely opened to secure better drainage an effort should be made as early as seems prudent to bring back the angles of the T into place.

I am convinced that an apparently negligible amount of blood entering the lungs during the operation may cause serious consequences. It is therefore my endeavor to conduct the operation so that not one drop is allowed to pass down the trachea. A double suction outfit in the hands of the assistants and meticulous vigilance on the part of all secure this result. The rubber tracheal extension tubes are in five sizes from which one may always be selected which will closely fit the lumen of the trachea.

Since I have put behind me the ambition of securing primary union and have abandoned the usual surgical methods of wound closure with scanty drainage my postoperative troubles have been materially reduced. Great care in closing the hypopharynx is essential but more essential to the life of the patient is a loose closure with abundant drainage of the superimposed tissues of the neck.

Septic infection must be forestalled by placing drainage in its path. My experience has led me to employ 4 small double tube drains wrapped in gauze. The tubes are open only at their distal and proximal ends. One pair is placed in each of the deep pockets at the end of the cross bar of the T. One is laid on each side just above the tracheal skin union and extends laterally to the full depth of the wound. They are left *in situ* for 5 or 6 days and kept clean and open by forcing water through one tube and sucking it out through the other. Then one tube is clamped and the salt solution forced out along the gauze about the tubes. Thus both gauze and tubes are cleansed. This is done 2 or 3 times a day.

A large tracheal cannula (36) is wound round with gauze impregnated with bismuth paste. The winding is so fashioned as to form

a conical cork. This is inserted into the trachea and should fit it as a cork does a bottle. The object of corking the trachea is to prevent tracheal secretions from contaminating the wound and wound secretions from entering the trachea. It also protects the tracheal skin union. In my hands it has been a very serviceable device especially later when infection occurs and discharge from the wound becomes profuse. Without tracheal plugging in the latter condition lung infection would be almost inevitable. The corking is maintained until healing is complete. The wound is dressed in the usual way. A rubber apron is placed over the end of the cannula to catch the tracheal secretions.

During the repair period of the operation the patient is given little or no anesthetic. General anesthesia is imperative only from the time the trachea is opened until the hypopharynx and esophagus are closed.

3. *After treatment.* The immediate treatment usual after any major operation is carried out. I will speak only of the conditions peculiar to this operation. It is here that the skill and experience of the surgeon are often taxed to and even beyond the limit. The after treatment in laryngectomy cannot be delegated to an assistant or a member of the house staff. Painstaking constant care on the part of the surgeon is the only key to success. If infection occurs the surgeon must be at least one step ahead of it. I attribute the prohibitive surgical mortality of a few years ago and even more recently to four causes viz: careless preparation of the patient, prolonged general anesthesia, the entrance of blood into the lungs during the operation and mismanagement of the septic infection so common after operation. Another factor may be added. Rectal feeding and drop feeding by the mouth were depended upon prior to my demonstration many years ago that the esophagus would tolerate a permanent tube for weeks. Rectal feeding was one of the greatest fallacies that ever became rooted in the professional mind.

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the third day, cleansing of the wound begins. A suction apparatus is attached to one end of the double tube in each drain. Saline solution is gently introduced through the other end. The flow is continued until the wound is clean. This may have to be done several times in twenty four hours.

The local reaction in the neck is sometimes considerable and may simulate infection. If doubt exists in the surgeon's mind, he would do wisely to extend as widely as possible his drainage openings and keep a sharp outlook for extension along the muscular planes of the neck. If extension occurs these planes must be extensively opened and drained. Later if the discharge becomes excessive and if the hypopharyngeal sutures give way suction to remove saliva and pus is of inestimable value. Tubes are placed at the bottoms of the pockets and through the opening in the œsophagus. These project through the dressing and the nurse applies suction to them as frequently as is indicated. Dakin's solution has been useless in this work, since it may find its way into the trachea and cause intense irritation. I prefer a 2 per cent solution of mercurochrome used sparingly.

If as sometimes happens tracheitis follows the operation suction applied through a catheter passed down the trachea unloads it and may prevent gravitation pneumonia. With the larynx gone normal expulsive cough is impossible hence the inability on the part of the patient to unload his trachea and bronchi. Here suction carefully and properly applied has in my hands saved many lives not only in this operation but in all conditions where the trachea is open and the bronchial tree blocked with secretion. On three occasions a serious asphyxia was relieved by removing dried masses of secretion with the aid of the bronchoscope from the region of the tracheal bifurcation.

Much of our success in piloting these cases across the postoperative period is due to the permanent feeding tube. Nourishment to the point of tolerance discourages septic infection. Of what avail are the feeble efforts of the surgeon against infection in a starving patient? For over 20 years I have used this

method of feeding without one untoward result traceable to its use. It is begun just as soon as the anæsthetic period is over. For two days from one half to two thirds the caloric requirement is given then the amount increased to tolerance.

Any well balanced diet capable of being reduced to a fluid or semi-solid state may be used. Fruit and vegetable juices are essential and must be added to the dietary as early as possible. Gravitation serves for ordinary liquids the piston syringe for thicker ones. The patient being propped up in bed the food is very slowly introduced. After each feeding (which may be once in 2½ to 4 hours) a few ounces of water are passed through the tube to cleanse it. Several times a day the pharynx is cleared of mucus by suction and the mouth and teeth are cleaned with mouth wash and tooth brush. Dressings are changed as often as need be to keep the surface of the wound free from secretion. In foul cases the wound packing may require several changes in 24 hours. The patient must be shifted from side to side and encouraged to sit propped up in bed.

Extensive sloughing may be a blessing in disguise. I believe that it has in several of my advanced intrinsic cases been a determining factor in the ultimate cure by eradicating hidden cancer infection in the vicinity of the larynx.

The high percentage of recurrences in all but the total laryngectomies observed in my own experience and in that of many of my confreres in America makes me lean strongly toward the more radical operation.

The low surgical mortality (less than 2½ per cent) in my cases is due to the elimination of unfavorable cases and to the modification of general surgical principles to suit this peculiar and difficult field.

Loss of speech is the serious drawback in total laryngectomy and turns many patients toward radium and the less radical avenues of escape. Radium is at present on trial. So far in my experience it has proved very ineffectual beguiling many to their death. I have many patients whose whisper can be distinctly heard at close range in a quiet room. One patient operated upon 9 years ago

has acquired loud speech and can talk over the telephone. He can even count up to twenty on one stomachful of air. In some way known only to himself he opens his esophagus fills his stomach with air and makes audible speech by slowly expelling the air. Three other patients have acquired audible speech since the above was written making 4 in 95. Education along this line would I believe result in many more. Several are engaged in large enterprises which they conduct as successfully as they did before their operation. Some have informed me that their stenographers can take their dictation with ease. They do not complain of discomfort during the cold months not even in Canada. To protect the lungs against cold dry air a bulging wire screen covers the tracheal opening and extends several inches down and across the chest. Above this a high soft collar is worn to exclude the external air. The patient breathes the warm moist air coming from beneath the clothing. This simple device has done much to protect the trachea and lungs during the cold months.

The artificial larynx devised by me is being used with success by many of my patients. Through this I hope to remove to some extent the stigma of silence attached to laryngectomy to brighten the prospect for the victim and to induce him to accept surgery his only means of deliverance.

The effort to place the surgical treatment of cancer of the larynx on a better basis has been an uphill struggle. There is a wide spread feeling in the profession that cancer of the larynx is a hopeless disease. This is supported by the results of operations done in the later stage of the disease in which the victim is made to pass through a double death. Partial removal of the larynx or attempts to remove the growth by thyrotomy or suspension in cases entirely unsuited to these procedures have heaped discredit upon the whole procedure. Finally there has been the failure of the profession at large to realize that prolonged hoarseness in a person of cancer age may be and very often is the first sign of danger demanding immediate intelligent and painstaking investigation by one competent to differentiate between the sim-

ple and malignant diseases in this field. If cancer has its inception external to the laryngeal box its early detection must be of little avail to the victim until more light on this disease is vouchsafed us. In my opinion we are helpless in this situation. Hence the only patients in whom early detection is of importance are those (the intrinsic) in which hoarseness is an early symptom.

I wish in closing to make two statements. (1) In incipient intrinsic cancer of the larynx the outlook is very hopeful if we apply to the cure the same sound sense exhibited by the general surgeon in the treatment of cancer elsewhere in the body. The general surgeon operates radically. (2) The laryngectomized patient is not as many believe a surgical curiosity a derelict a miserable thing apart from all his kind. He is usually a useful active citizen capable of continuing his life's work of supporting his family and of realizing if not to its full extent at least to a large extent the joy of living.

The artificial larynx was demonstrated on a patient.

#### DISCUSSION

DR D. BRYSON DELAAN. It is not my purpose to discuss the different methods at present advocated for the relief of laryngeal malignant disease. Thyrotomy, partial laryngectomy, total laryngectomy for intrinsic carcinoma, radical operations in extrinsic cases, all have their advocates who are able to present impressive arguments in their favor. Radiology has its adherents who are bringing forward highly interesting evidence in support of their views. Positive knowledge however as to the relative merits of these various methods has not yet been established. It is this fact that I particularly wish to emphasize and I wish to indicate as emphatically as possible what I consider the only satisfactory way in which it can be attained, namely through the collective investigation of large numbers of cases in the hands of the most thoroughly competent men. Without a knowledge of the history of laryngectomy it is hardly possible that any one could realize the importance of what Dr MacKenty has done in offering this large series of well studied cases.

The story is long and its details are discouraging to a degree which 15 years ago led me to believe that up to that time operations in general for the cure of carcinoma of the larynx had in the aggregate materially lessened the sum total of human life, granting that the average duration of life after the disease has become discoverable is about 2 years. Evidently the main idea in the mind of Dr. Mac-

the third day cleansing of the wound begins. A suction apparatus is attached to one end of the double tube in each drain. Saline solution is gently introduced through the other end. The flow is continued until the wound is clean. This may have to be done several times in twenty four hours.

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The effort to place the surgical treatment of cancer of the larynx on a better basis has been an uphill struggle. There is a wide spread feeling in the profession that cancer of the larynx is a hopeless disease. This is supported by the results of operations done in the later stage of the disease in which the victim is made to pass through a double death. Partial removal of the larynx or attempts to remove the growth by thyrotomy or suspension in cases entirely unsuited to these procedures have heaped discredit upon the whole procedure. Finally there has been the failure of the profession at large to realize that prolonged hoarseness in a person of cancer age may be and very often is the first sign of danger demanding immediate intelligent and painstaking investigation by one competent to differentiate between the sim-

ple and malignant diseases in this field. If cancer has its inception external to the laryngeal box its early detection must be of little avail to the victim until more light on this disease is vouchsafed us. In my opinion we are helpless in this situation. Hence the only patients in whom early detection is of importance are those (the intrinsic) in which hoarseness is an early symptom.

I wish in closing to make two statements. (1) In incipient intrinsic cancer of the larynx the outlook is very hopeful if we apply to the cure the same sound sense exhibited by the general surgeon in the treatment of cancer elsewhere in the body. The general surgeon operates radically. (2) The laryngectomized patient is not as many believe a surgical curiosity, a derelict, a miserable thing apart from all his kind. He is usually a useful active citizen, capable of continuing his life's work of supporting his family and of realizing if not to its full extent at least to a large extent the joy of living.

The artificial larynx was demonstrated on a patient.

#### DISCUSSION

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The story is long and its details are discouraging to a degree which 15 years ago led me to believe that up to that time operations in general for the cure of carcinoma of the larynx had in the aggregate materially lessened the sum total of human life, granting that the average duration of life after the disease has become discoverable is about 2 years. Evidently the main idea in the mind of Dr Mac-



the third day, cleansing of the wound begins. A suction apparatus is attached to one end of the double tube in each drain. Saline solution is gently introduced through the other end. The flow is continued until the wound is clean. This may have to be done several times in twenty four hours.

The local reaction in the neck is sometimes considerable and may simulate infection. If doubt exists in the surgeon's mind he would do wisely to extend as widely as possible his drainage openings and keep a sharp outlook for extension along the muscular planes of the neck. If extension occurs these planes must be extensively opened and drained. Later if the discharge becomes excessive and if the hypopharyngeal sutures give way suction to remove saliva and pus is of inestimable value. Tubes are placed at the bottoms of the pockets and through the opening in the œsophagus. These project through the dressing and the nurse applies suction to them as frequently as is indicated. Dakin's solution has been useless in this work since it may find its way into the trachea and cause intense irritation. I prefer a 2 per cent solution of mereurochrome used sparingly.

If as sometimes happens tracheitis follows the operation suction applied through a catheter passed down the trachea unloads it and may prevent gravitation pneumonia. With the larynx gone normal expulsive cough is impossible hence the inability on the part of the patient to unload his trachea and bronchi. Here suction carefully and properly applied has in my hands saved many lives not only in this operation but in all conditions where the trachea is open and the bronchial tree blocked with secretion. On three occasions a serious asphyxia was relieved by removing dried masses of secretion with the aid of the bronchoscope from the region of the tracheal bifurcation.

Much of our success in piloting these cases across the postoperative period is due to the permanent feeding tube. Nourishment to the point of tolerance discourages septic infection. Of what avail are the feeble efforts of the surgeon against infection in a starving patient? For over 20 years I have used this

method of feeding without one untoward result traceable to its use. It is begun just as soon as the anæsthetic period is over. For two days from one half to two thirds the caloric requirement is given then the amount increased to tolerance.

Any well balanced diet capable of being reduced to a fluid or semi solid state may be used. Fruit and vegetable juices are essential and must be added to the dietary as early as possible. Gravitation serves for ordinary liquids the piston syringe for thicker ones. The patient being propped up in bed the food is very slowly introduced. After each feeding (which may be once in  $2\frac{1}{2}$  to 4 hours) a few ounces of water are passed through the tube to cleanse it. Several times a day the pharynx is cleared of mucous by suction and the mouth and teeth are cleaned with mouth wash and tooth brush. Dressings are changed as often as need be to keep the surface of the wound free from secretion. In foul cases the wound packing may require several changes in 24 hours. The patient must be shifted from side to side and encouraged to sit propped up in bed.

Extensive sloughing may be a blessing in disguise. I believe that it has in several of my advanced intrinsic cases been a determining factor in the ultimate cure by eradicating hidden cancer infection in the vicinity of the larynx.

The high percentage of recurrences in all but the total laryngectomies observed in my own experience and in that of many of my confreres in America makes me lean strongly toward the more radical operation.

The low surgical mortality (less than 2½ per cent) in my cases is due to the elimination of unfavorable cases and to the modification of general surgical principles to suit this peculiar and difficult field.

Loss of speech is the serious drawback in total laryngectomy and turns many patients toward radium and the less radical avenues of escape. Radium is at present on trial. So far in my experience it has proved very ineffectual beguiling many to their death. I have many patients whose whisper can be distinctly heard at close range in a quiet room. One patient operated upon 9 years ago

has acquired loud speech and can talk over the telephone. He can even count up to twenty on one stomachful of air. In some way known only to himself he opens his oesophagus fills his stomach with air and makes audible speech by slowly expelling the air. Three other patients have acquired audible speech since the above was written making 4 in 95. Education along this line would I believe result in many more. Several are engaged in large enterprises which they conduct as successfully as they did before their operation. Some have informed me that their stenographers can take their dictation with ease. They do not complain of discomfort during the cold months not even in Canada. To protect the lungs against cold dry air a bulging wire screen covers the tracheal opening and extends several inches down and across the chest. Above this a high soft collar is worn to exclude the external air. The patient breathes the warm moist air coming from beneath the clothing. This simple device has done much to protect the trachea and lungs during the cold months.

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Kenty has been to sweep away the errors of the past and to evolve a system of procedure which should ultimately determine the real value of surgical intervention for the cure of laryngeal cancer. The development of his system has progressed to a point where it may well challenge our attention and respect. One has only to compare the results of the older operators with his to understand why.

Laryngectomy was first performed by Watson in 1868 about 60 years ago. The operation was taken up by the general surgeons both here and abroad. Billroth of Vienna being one of the first to employ it in Europe. With the exception of a few cases it was universally unsuccessful. Somewhat later cases were operated upon by laryngologists who in some instances were more successful than were the general surgeons for the reason that they had a better knowledge of the throat and its functions and perhaps a more refined appreciation of the delicacy and complicated nature of the parts. The earliest laryngologist thus to distinguish himself was Dr. J. Solis Cohen of Philadelphia who may well be called the father of successful laryngectomy in the United States. His celebrated case operated on in 1884 included the cardinal points of the best works of today.

The causes of failure were many. Little regard was paid to the proper selection of cases. As a rule each operator was self-trained perhaps never having seen the operation performed. Thus he had to make his own way not seldom at the sacrifice of his first attempts. He was obliged to work in hospitals not adapted to the care of such patients and was handicapped by untrained assistants to whom in many instances was committed the after-care of the patient. His technique was crude or so imperfectly carried out that with the faulty after treatment small chance was left to the patient to survive. Case after case was lost seldom any report being made of them while the few successful ones were widely heralded. Good surgeons tested them selves upon a few cases and soon discouraged abandoned the operation. There was no persistent continuity of effort by individuals. No statistics that could be relied upon were available. How well Dr. MacKenty has met the requirements of the situation, the result of his work abundantly shows.

Thirty years ago I was invited to open a discussion on thyrotomy in the Section of Laryngology at the annual meeting of the British Medical Association held in London in 1895 in company with Sir Henry T. Buthin, Sir Felix Semon, Sir Dundas Grant and other leading specialists including Dr. John N. Mackenzie of Baltimore. On that occasion I tried to lay especial emphasis upon several principles which had impressed their importance upon me. First, the necessity for the correct diagnosis of the growth and wise judgment as to the possibilities of its successful removal and second the age and vitality of the patient. He must suffer from no physical defect likely to complicate recovery or seriously annoy him afterward. He

should be of a cheerful and courageous temperament and finally his intelligence should be fair and his surroundings such as to make it possible for him to exist with moderate comfort after operation.

With regard to the operator I said: To secure the best success the operator should first of all be a surgeon thoroughly practiced in all that contributes to the making of a good operator. He should have had special training in the surgery of the neck and in the physiology as well as the anatomy of the laryngeal region. He should be a master of aseptic methods and of good judgment in the after-care of the case. Finally he should have at his disposal the resources of a perfectly equipped and thoroughly well managed modern hospital of the best class. As the dangers not only of operation but of the first days after operation are of conceded importance it is necessary that this part of the case be managed with extreme care. Many a patient has died of a preventable accident whose life would have been spared if he had had the constant care of a highly skilled watcher. As had been first suggested by Solis Cohen and eloquently insisted upon by him, such a case should never be entrusted to the interne nor to the assistant without experience in such matters but to an attendant no less competent than the surgeon himself qualified to appreciate the special necessities of the patient and to meet promptly any emergency that might arise. It can not be insisted upon too urgently that cases of laryngectomy are desperate at the best, both as to immediate and as to ultimate results and that with our present limited knowledge of the subject no amount of caution however great will avail in preventing a high percentage of failures. With the sources of danger so numerous so constant and so subtle it is impossible for too great vigilance, foresight or experience to be brought to bear against them or for the urgency of this demand to be overstated. While fully appreciating the work already done and recognizing the hopeful outlook of the future I have emphasized the difficulties, uncertainties and dangers of the situation for the purpose of insisting upon the gravity of the subject and of discouraging the class of effort which has so often been brought to bear upon these cases. Let me beg you I said not to misunderstand the proposition which I am about to offer but to receive it in the spirit in which it is given with the largest possible share of humane impulse and of generous breadth of view. I am strongly of the opinion that for a time both the welfare of patients operated upon as well as the interests of science demand that the indiscriminate performance of capital operations upon the larynx should cease. In most great centers there are individual surgeons or groups of operators who are especially well fitted both as to personal qualification and hospital facilities for the successful performance of this work as proved by the records which they have already made. Let such men surround themselves with the proper assistants let them systematize their efforts and use all

diligence in the perfecting of appliances and methods and in the study of the cases under them let them keep careful and accurate record of everything pertaining to the history of their work then resign to them temporarily the care of as many cases of laryngeal cancer as possible When a sufficient amount of material has been collected let them place it upon a substantial statistical basis and as one advance after another has been made let them give to the profession the general results Under this system we would soon learn whether the radical extirpation of epithelioma is on the whole unjustifiable or whether as we have the best reasons for hoping it will have been proved to be a substantial success The suggestions just quoted were probably too altruistic to appeal to my audience for it was a decade before any real advance was made Moreover thirty years ago collective investigation was not considered and the ideas of the Mayo brothers and of Cabot had not yet been announced

About 20 years ago Professor Gluck of Berlin taking up the accumulated ideas of his predecessors put the ideas in practice and added some of his own Soon he made his work known and gained a large following He also gathered a considerable number of cases It was his custom to operate upon practically all who came to him apparently little deterred by conditions of great advancement of the disease At the 16th International Medical Congress held at Budapest in 1909 he exhibited to us 4 cases upon which he had performed his most extensive operation for the removal of widespread disease of the throat On one patient there had been a total extirpation of the larynx with removal of affected adjacent parts of the esophagus pharynx tongue and lymph nodes All 4 patients had survived for a period of 3 years and all appeared to be in fair

condition The mutilation in these cases was extensive the whole front of the throat having been obliterated, leaving a vacant space of surprising extent

These cases proved the possibility of such radical resections of important parts of the throat and secondly the possibility of prolonging life when carcinoma had progressed so far outside the larynx as to make a simple laryngectomy useless Undoubtedly, Gluck's most important contribution was the example he gave of the importance of organization and concentration in the carrying on of such work Imperfect and unconvincing as may have been many of his own results by reason of his high rate of mortality he contributed a significant precedent

Fortunately there is another who appearing before us today presents a system which embraces the best ideas and methods of the past To the e he has added many ingenious improvements of his own Hesitating to make formal deductions upon insufficient surmises he has waited until the volume of his statistical material has grown to proportions large enough to furnish convincing proof of the actual value of his long continued efforts In his work as in that of Dr Quick in the field of radium my ideal of 30 years ago has at last been realized

From now on it will be conceded that to those best qualified should be committed this work so that by their well directed efforts they may bring us nearer and nearer to a definite solution of the problems obscuring the subject of laryngeal cancer Meanwhile they can train up others to follow in their way surely we are justified in hoping that the experience of the past 60 years has brought the beginning of a new era full of the promise of better things

# THE CLINICAL VALUE OF THE ERYTHROCYTE SEDIMENTATION REACTION IN SURGERY

By E. H. RUBIN, M.D., New York City  
From the Department of Surgery, New York School of Medicine

SINCE the work of Fahraeus (6) on the blood of pregnant women a large number of papers have appeared on the so called erythrocyte sedimentation reaction. In about 300 reports that have come to our attention the consensus of opinion is that the test is a valuable clinical adjunct in the following of the course of a disease. Except in certain surgical conditions which will be discussed later it has little diagnostic value the greater field of usefulness being that of an indicator of the degree of toxicity of a pathological process and of the reaction of the patient. Repeated testing of the blood is believed to show the progressive improvement or decline in a patient's condition. The sedimentation reaction has been especially recommended in chronic diseases such as tuberculosis when the patients are kept under observation for a considerable length of time. In such cases it is considered by von Tegtmeier (27) Brinkmann and Beck (2) Delbays (4) and others to be of greater significance than the temperature chart. It has also been used with equally favorable results in obstetrics and gynecology, surgery, pediatrics and psychiatry.

The sedimentation reaction utilizes the speed with which red blood cells settle in a citrated column of blood. This is determined either by observing the distance which the cells have settled in a given period of time Westergren method (28) or by noting the time it takes for the top layer of cells to reach a certain distance in the container Linzenmeier method (17). These two basic methods have been subjected to frequent modifications by different investigators so that a comparison of their results is difficult. We have been using a method recommended by Morris (11) which gives the sedimentation values in volume per cent of the entire column of blood. Our experience with this method in cases of tuberculosis has

demonstrated its simplicity and accuracy. The test is made in the following manner:

Into a sterile 2 cubic centimeter Record syringe a solution of 3.8 per cent sodium citrate is drawn up to the 4 mark. Blood is then aspirated from an arm vein to the 2 cubic centimeter mark giving a dilution of 1:4. After thorough mixing in small Wassermann test tubes the samples are taken to the laboratory where the blood is drawn up into long serological pipettes, graduated into hundredths, placed in a suitable rack and the layer of clear plasma observed at the end of 1, 2, and 24 hours and read directly in per cent. The 2 hour reading is the most significant one.

It has been repeatedly emphasized that the usefulness of the test depends upon its frequent repetition during the course of an illness and that single determinations merely represent the momentary state of the individual. For that reason it seemed desirable to study the test in acute surgical conditions and to correlate the clinical findings with the sedimentation reaction.

TABLE I—FINDINGS IN FIFTEEN CONTROLS AND FOUR PATIENTS

| N  | Age | Sex | Clinical Diagnosis and Comments | Sedimentation P.C. |      |       |
|----|-----|-----|---------------------------------|--------------------|------|-------|
|    |     |     |                                 | 1 hr               | 2 hr | 24 hr |
| 1  | 3   | M   | Medicinal t d t                 | 1                  | 3    | 5     |
| 2  | 3   | M   | Medicinal t d t                 |                    | 3    | 5     |
| 3  | 3   | M   | Medicinal t d t                 |                    | 3    | 5     |
| 4  | 6   | M   | Medicinal t d t                 |                    | 5    | 9     |
| 5  | 6   | M   | Medicinal t d t                 |                    | 5    | 14    |
| 6  | 6   | M   | Medicinal t d t                 |                    | 5    | 7     |
| 7  | 6   | M   | Medicinal t d t                 | 1.5                | 3    | 10    |
| 8  | 26  | M   | Medicinal t d t                 |                    | 5    | 5     |
| 9  | 33  | M   | Medicinal t d t                 |                    | 5    | 5     |
| 10 | 33  | M   | Medicinal t d t                 | 5                  | 5    | 10    |
| 11 | 33  | F   | Hospital urse                   |                    | 5    | 7     |
| 12 | 33  | F   | Hospital urse                   | 4                  | 7    | 14    |
| 13 | 33  | F   | Hospital urse                   | 5                  | 5    | 14    |
| 14 | 6   | F   | Hospital urse                   | 5                  | 5    | 14    |
| 15 | 3   | F   | Hospital urse                   | 5                  | 5    | 14    |
| 16 | 37  | M   | G. tract us (displaced)         |                    |      |       |
| 17 | 3   | M   | Dislocation femoral cartilage   |                    |      |       |
| 18 | 33  | M   | Factor 1 1/2 d fibula           | 6                  | 5    | 14    |
| 19 | 7   | F   | Chronic constipation            | 4                  | 5    | 14    |

Sedimentation reaction was within normal limits

TABLE II—READINGS IN CASES WITH SFDI  
MENTATION VALUES FROM 10 TO 20 PER CENT

| No. | Age | Sex | Clinical Diagnosis and Condition  | ed me. status<br>P. C. E. T. |    |       |
|-----|-----|-----|---|------------------------------|----|-------|
|     |     |     |   | the                          | hr | 24 hr |
| 10  | 4   | M   | Tuberculosis w/1 Myrad ratio<br>Focus excised m th<br>previo by Ce distion good   |                              | 5  | 34    |
| 1   | 35  | M   | N d puen ture wou d l th<br>emion ce N an l section   | 4                            | 9  | 36    |
| 11  | 7   | M   | F t l sbul Co d t g section   |                              |    |       |
| 1   | 6   | M   | Hypos trophy prostat Qu t<br>ble m l T P R  | 3                            | 9  | 17    |
| 4   |     | M   | Tuberculosis l k d n y N ph ec<br>t my am th p ly T l<br>R mal Chest n g ave  | 4                            |    |       |
| 5   | 36  | M   | Ca cin m eosoph gus N p<br>f toxic boort T P R<br>rm l Dsch ng d limp ed  | 4                            |    |       |
| 6   | 5   | F   | Ch n ppe dact E teropato<br>nd g nut l d h eus  |                              |    |       |
|     |     |     | Appe dect my 8 days p evous<br>ly T P R orm l   | 4                            |    | 3     |
| 7   |     | F   | Co g t l d h e Ptos<br>cec m. Eent t ry l p oeat<br>my 3 days pre vously T P R<br>m l   | 3                            | 5  | 43    |
| 8   |     | M   | Cru h e j r y t b g toe with<br>a ne of distal pl lax<br>d ys alt d m u s s o W d   | 4                            |    | 36    |
| 9   | 7   | M   | A l n s s e l r o s G e d t r m o<br>Ch t n p p e d e c t i o n y T P R<br>m l  | 3                            | 5  | 40    |
| 11  | 18  | M   | Fra t sb l Co tus bo t<br>shou ld T P R m l   | 6                            |    | 4     |
| 12  | 31  | F   | Hypophy it mo E l t<br>l ad nom p l tary mo th<br>previo us ly T P R m l<br>Co d t good   | 6                            |    | 43    |
| 13  | 8   | M   | D od l l R d blood lla<br>s g o o o o   | 7                            |    | 44    |
| 14  | 5   | M   | Hemorrh ds 7 days site d<br>mass  | 5                            |    | 37    |
| 15  | 8   | M   | Osteomy l t a l e f t m Remo<br>l f e c t e s t r u m d c u s t i e m<br>mo th p r v u s l y C e d i s t i o<br>good              | 8                            |    | 47    |
| 16  | 7   | M   | D i v e r t i c u l m b l d d M u l t p l<br>p h o s l l l d l f t h y d r o  | 6                            |    | 44    |
| 17  | 35  | M   | F u o r e t h r s d p e e n u s<br>w e e k s f t p r p b e c y s t<br>m y T P R o r m l   | 5                            |    | 4     |
| 18  | 37  | M   | Ch n c p t t u s d p u d y m a<br>t   | 9                            |    | 5     |
| 19  | 34  | M   | D b e t e s m l l u s T h m b o<br>s l u s b i t e r a s b g t o e A m<br>p l y t l l g 3 w e e k s p r e v i o u s<br>m th l a t | 6                            |    | 48    |
| 4   | 7   | F   | F a c t u r e e c k f f m F l a s t<br>t g m o t h T P R r m a l  | 7                            |    | 49    |

T=Temperature P=Pulse R=Respiration

Table I represents the findings in 15 healthy controls and 4 patients. With the exception of Cases 10 and 15 the 2 hour readings listed here are in agreement with those obtained by Mornss on his healthy controls—up to 5 per cent for men and up to 10 per cent for women.

Table II gives the readings in cases with slight increase in sedimentation values up to 20 per cent. The majority of the readings are postoperative or in afebrile cases. The

TABLE III—CASES IN WHICH THE SEDIMENTATION READINGS WERE FROM 20 TO 40 PER CENT

| N  | Ag | Sc | Ch       | ID  | g     | a    | d    | C     | dm     | Ged m t t<br>Pr Ce t |     |    |
|----|----|----|----------|-----|-------|------|------|-------|--------|----------------------|-----|----|
|    |    |    |          |     |       |      |      |       |        | abr                  | abr | z  |
| 41 | 4  | M  | Ch       | sc  | oste  | my   | lit  | f     | mur    | 5                    |     |    |
| 42 | 36 | M  | Emphysem | d   | hr    | c    | b    |       |        | 11                   |     |    |
| 43 | 44 | F  | St       | act | eroph | gus  | ill  | w     | g      | 9                    | 5   | 10 |
| 44 | 6  | M  | Ch       | act | ical  |      |      |       |        | 51                   |     |    |
| 45 | 3  | M  | Care     | m   | l     | r    | y    | T     | P      | 7                    | 7   | 3  |
| 46 | 7  | F  | H        | m   | l     | toe  | w    | th    | p      | 9                    |     | 54 |
| 47 | 9  | M  | m        | th  | l     | w    | g    | p     | pe     | 10                   |     | 3  |
| 48 | 3  | M  | Ac       | t   | p     | pe   | d    | e     | t      | 8                    | 3   | 51 |
| 49 | 3  | M  | A        | te  | p     | pe   | d    | e     | t      | 0                    | 3   | 49 |
| 50 | 3  | M  | D        | o   | d     | nal  | ker  | Pyl   | plasty | 5                    | 5   | 57 |
| 51 | 38 | F  | Ch       | sc  | p     | pe   | d    | e     | t      | 13                   | 7   | 53 |
| 52 | 36 | M  | N        | e   | d     | ic   | m    | ot    | f      | 5                    | 8   | 48 |
| 53 | 4  | M  | V        | l   | e     | s    | th   | e     | m      | 4                    | 8   | 51 |
| 54 | 4  | F  | Fis      | t   | l     | Empe | stur | o     | o      | 7                    | 1   | 5  |
| 55 | 60 | M  | B        | l   | l     | l    | l    | l     | l      | 4                    | 1   | 5  |
| 56 | 40 | M  | R        | t   | t     | e    | Rm   | d     | d      | 4                    | 1   | 5  |
| 57 | 3  | M  | Cerve    | l   | ymph  | d    | e    | pathy | b      | 3                    | 5   |    |
| 58 | 40 | M  | Ca       | m   | l     | e    | yx   | D     | e      | 5                    | 3   | 56 |
| 59 | 9  | M  | day      | f   | low   | e    | r    | d     | no     | 9                    | 14  | 52 |
| 60 | 46 | M  | T        | b   | e     | l    | p    | e     | t      | 1                    | 17  | 59 |
| 61 | 6  | M  | C        | d   | e     | t    | d    | g     | u      | 16                   | 62  |    |
| 62 | 6  | M  | La       | t   | e     | b    | o    | t     | e      | 1                    | 17  | 59 |
| 63 | 73 | F  | Fact     | i   | m     | s    | w    | e     | e      | 37                   | 54  |    |
| 64 | 30 | F  | T        | b   | e     | u    | l    | u     | m      | 1                    | 5   | 63 |
| 65 | 66 | M  | P        | r   | u     | e    | i    | p     | ro     | 18                   | 65  |    |
| 66 | 7  | M  | Ca       | c   | m     | l    | e    | u     | ro     | 5                    | 18  | 58 |

T=Temperature P=Pulse R=R p too

relatively low readings are in agreement with the clinical findings. Of special interest are Cases 25 and 33. In the former a case of early carcinoma of the oesophagus with few symptoms and no clinical evidence of toxic absorption the 2 hour reading is only 10 per cent. The case of duodenal ulcer also gave a

TABLE IV--CASES IN WHICH THE SEDIMENTATION READINGS WERE FROM 40 TO 60 PER CENT

| No | Age | Sex | Clinical Diagnosis and Conditions                                       | Sedimentation<br>P Cent |    |       |
|----|-----|-----|---|-------------------------|----|-------|
|    |     |     |   | hr                      | hr | 24 hr |
| 67 | 33  | F   | Rectal stenosis, carcinoma of<br>broad Ovary                            |                         |    |       |
| 68 | 3   | F   | Chronic bronchitis with mucus<br>expectoration 2 weeks pre              | 7                       | 22 | 65    |
| 69 | 4   | M   | Fracture of humerus   | 3                       | 13 | 65    |
| 70 | 58  | M   | Cardiac metastasis  | 4                       | 23 | 6     |
| 71 | 70  | M   | Chronic bronchitis  | 4                       | 23 | 60    |
| 72 | 18  | F   | Acute appendicitis 3 days<br>long                                       | 27                      | 23 | 60    |
| 73 | 43  | M   | Two weeks of influenza<br>fever   | 7                       | 15 | 62    |
| 74 | 41  | M   | Chronic gastritis, abdominal<br>distension, vomiting, blood<br>in stool | 3                       | 17 | 62    |
| 75 | 37  | M   | Carcinoma of esophagus, died<br>2 weeks later                           | 5                       | 18 | 62    |
| 76 | 59  | M   | 1 week of influenza   | 36                      | 5  | 64    |
| 77 | 59  | M   | Chronic bronchitis, acute   | 41                      | 5  | 58    |
| 78 | 16  | M   | 1st degree burn, wounds<br>on arm                                       | 35                      | 16 | 64    |
| 79 | 5   | M   | Day of influenza  | 40                      | 5  | 63    |
| 80 | 41  | M   | Day of influenza  | 41                      | 55 | 64    |
| 81 | 7   | M   | Fracture of pelvis, T.P.R. norm   | 35                      | 55 | 73    |
| 82 | 17  | M   | Fracture of pelvis, T.P.R. norm   | 46                      | 56 | 69    |
| 83 | 37  | M   | Cardiac metastasis, with mucus<br>expectoration                         | 45                      | 59 | 68    |
| 84 | 3   | M   | Fracture of humerus, with mucus<br>expectoration                        | 45                      | 60 | 65    |
| 85 | 6   | M   | Carcinoma of esophagus, with mucus<br>expectoration                     | 45                      | 60 | 65    |

<sup>†</sup>T=Temperature P=Pulse R=Rotation

low reading in spite of the anemia & high in itself is a cause for more rapid sedimentation

In Table III are listed the cases with sedimentation readings ranging between 0 and 40 per cent. A comparison of this group of patients with the preceding ones will explain the higher values. In this group the temperatures are occasionally found elevated the operations are more recent and several cases of carcinoma and tuberculosis are included.

In Table IV are listed the cases with markedly accelerated reactions 10 to 60 per cent in 2 hours. The 19 cases include 7 cases of advanced cancer 1 of active progressive pulmonary tuberculosis 3 of postoperative syphilitic complications several being within the first week after operation. With the exception of Cases 74 and 80 the results are in agree-

ment with the clinical picture of these patients. The high reading on Case 74 may be due in part to the low red count which has been shown to accelerate sedimentation (8). Case 80 of fractured pelvis gave an unusually high reading.

A study of the composite tables in this paper will reveal that in general the graver lesions are accompanied by more accelerated sedimentation reactions but the exceptions are so frequent that it is evident that the test cannot be based on such a classification. However the momentary condition of each patient agrees better with the sedimentation reaction than with the temperature or leucocyte count both of which are frequently within normal limits in the presence of considerable tissue destruction. Increases in the sedimentation reaction followed surgical operations with a return to normal limits in uncomplicated cases in 3 to 4 weeks after operation or considerably after the temperature had reached normal. Complicated cases necessitating drainage remained high for longer periods and gradually improved with the betterment in the condition of the patient. Those with non surgical complications such as syphilis and tuberculosis gave higher readings than would be expected from the surgical conditions alone and did not show much change upon the improvement or even upon cure of the surgical affection. This is best illustrated by Table V which shows repeated tests on a group of patients during their hospital stay and after discharge into the out patient department.

The clinical value of the sedimentation reaction depends upon its frequent repetition during an illness. Single determinations merely indicate the momentary condition and are of no prognostic importance since any change in the patient's condition may alter the result. This view is stressed by all who advocate the test. Considerable emphasis has been placed on the sedimentation reaction as a diagnostic aid in the differentiation between benign and malignant neoplasms and as a criterion of cure of the latter when they are completely removed. Lohr (19) believes the reaction is of diagnostic help in the differential diagnosis between ulcer and cancer of the stomach sedimentation being more

The clinical value of the sedimentation reaction depends upon its frequent repetition during an illness. Single determinations merely indicate the momentary condition and are of no prognostic importance "since any change in the patient's condition may alter the result." This view is stressed by all who advocate the test. Considerable emphasis has been placed on the sedimentation reaction as a diagnostic aid in the differentiation between benign and malignant neoplasms and as a criterion of cure of the latter when they are completely removed. Lohr (19) believes the reaction is of diagnostic help in the differential diagnosis between ulcer and cancer of the stomach, sedimentation being more





normally high red count (7 000 000). More recently Eick (5) reported a series of 50 cases of cancer of the uterus which were kept under observation for 4 years. He found the sedimentation reaction of little value in diagnosis since inoperable cases also gave normal values but repeated tests were helpful in prognosis and paralleled the clinical findings.

Although our study includes relatively few carcinoma and ulcer cases our observations are in agreement with those of Lobhardt. From the nature of the reaction its non-specificity and its tendency to be more marked with the increased absorption of broken down products it is not surprising that it fails to be of great help in cases in which confirmatory evidence would be most desirable. Advanced cases are diagnosable without the test although in such instances an accelerated sedimentation reaction might be of some value. Moreover there are frequent borderline reactions of moderate acceleration and their interpretation would be difficult. Hoffgaard's 13 moderately accelerated reactions with ulcer and 19 with cancer illustrate this. Since the presence of malignant tissue does not necessarily cause an accelerated reaction it is obvious that the test cannot be depended upon to determine postoperative residue of malignant tissue as advocated by Guenz (11), Gragert (10) and Giesecke (9). But we have no proof from our own study to offer.

Friedlander, Falta, Bronnikoff, Rumpf, Hallberg and Pewny have found the test of practical value in gynecology and feel that it is of greater value than the temperature or leucocyte count. They are guided by the test in deciding the advisability and time for operation and other gynecological procedure.

In fractures osteomyelitis inflammations of various organs and tracts the observations of Lohr (20) are generally accepted. In diseases of the liver a delay in the sedimentation reaction has been found of diagnostic value while Joseph and Marcus (16) alone have found the test valuable in the differential diagnosis between acute appendicitis and adnexitis. Within the first 30 hours they obtained no increase in the sedimentation reaction in cases of appendicitis but an immediate rise in cases of adnexitis.

## SUMMARY

1. In surgery the erythrocyte sedimentation reaction was found to be a more reliable indication of the condition of the patient than the temperature chart.

2. Its diagnostic and prognostic value were secondary to its value in indicating the acuteness of a process.

3. Extrasurgical complications such as syphilis or tuberculosis tended to maintain high readings in spite of the improvement or even cure of the surgical affection. In the absence of such complications repeated tests may guide in the discharge of patients although for many reasons it would be impractical to keep patients in the hospital until the reaction had reached normal limits.

4. Because the test indicates the severity of tissue destruction it should be of value in determining the advisability and time for operation.

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# RUPTURE OF THE UTERUS FOLLOWING THE ADMINISTRATION OF PITUITARY EXTRACT

BY J GARLAND SHERRILL MD FACS LOUISVILLE KENTUCKY

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**R**UPTURE of the uterus following the administration of pituitary extract was brought to our attention by two cases

In the first case 1927 the rupture was associated with a transverse presentation and dystocia from contracted pelvis. The patient came under observation some 4 hours after the rupture which occurred during efforts at version. Recovery followed laparotomy with suture of the uterus.

The second case which is the basis of this contribution is that of a healthy young wife at the conclusion of her first pregnancy. The history showed considerable difficulty in labor with some inertia instrumental delivery and a manual extraction of the placenta. At the conclusion of this latter step marked hemorrhage occurred and the patient went into serious collapse. She rallied in a short time. During the progress of the labor she received three doses of obstetrical pituitrin with  $\frac{1}{2}$  cubic centimeter in each dose at 2 hour intervals. A slight tear of the perineum was sutured.

Following the delivery the convalescence progressed satisfactorily until the ninth day at which time she developed some fever 103 degrees F with sharp chill. During the next 2 days she showed some improvement. On the twelfth day after labor she again had a chill and fever. There was but little discharge and no odor.

On the thirteenth day I first saw her. The perineal wound looked healthy. There was a small amount of swelling on the right side of the vagina which I took to be thickening about the veins at the pelvic wall. No defect in the vaginal wall was detected at this examination. The uterus was not unduly enlarged and it was not tender. The abdomen was soft and there was no tenderness or boggy mass in the pelvis.

On the fifteenth day she entered Norton Infirmary temperature 99.4 degrees, pulse 120, respiration 24. At this time beyond a marked anemia she did not look particularly ill.

At my second examination a small opening in the right vaginal wall was observed which admitted the tip of the index finger. Very slight moisture was noted at this point. From the previous thickening and the appearance of this defect in the wall the conclusion seemed justified that this rather than the uterine cavity was the site of the infection.

Blood cultures on two different occasions were negative after 24 and 48 hours. Blood examination showed hemoglobin 45 per cent, red cells 3,300,000, leucocytes 9,500, no malarial parasites.

She must have had a severe blood loss at the time of labor.

The uterus at this time remained about the same very little tenderness being present. No pelvic boggy mass was observed. The abdomen remained flat soft and not tender. In view of these symptoms an expectant plan of treatment was followed.

A chill was recorded on the sixteenth and seventeenth days of her convalescence with temperature 103.6-103.8 degrees. No chill occurred on the eighteenth day but a very severe one on the nineteenth day with temperature 105.4 degrees.

Notwithstanding the failure to obtain a growth from the blood, 20 cubic centimeters 1 per cent solution of mercurchrome 220 was given intravenously when the temperature had fallen to 102.6 degrees. A sharp reaction occurred with rise to 103.2. In 12 hours the temperature was normal but reached 103.8 24 hours after the injection. The temperature showed a gradual decline reaching normal 4 days later the twenty third day after delivery. On the twenty fourth day a sharp chill was followed by a rise to 104.8 degrees. After 3 days of apparent improvement the temperature again rose to 103.2 with chilly sensation. After an intermission of 2 days on the thirtieth day a severe chill with temperature of 106.2 sorted the conclusion that further delay was not permissible.

She had had one intra uterine irrigation followed by institution of mercurchrome 2 per cent and also some vaginal irrigations.

On September 4 operation was performed. Examination under an anesthetic revealed a circular tear at the ring of Bandl. An exploration of the uterine cavity permitted the passage of a sponge holder used without any force through a rent in the fundus making positive the diagnosis of rupture which had been considered previously only as a possibility.

When the abdomen was opened the uterus was found to be quite soft and friable but not much enlarged. Two small tears were observed on its peritoneal surface. After its removal these tears were found to connect in each instance with a somewhat wide separation of the muscular and mucous coats. There was no evidence of any peritonitis about the tear or any other portion of the uterus which is a rather surprising observation. The torn uterine wall gave positive evidence that the rupture had existed for some time and was not an immediate one.

*Pathological report by Dr. Stuart Graves.* Gross description. Specimen consists of uterus with oviduct. Uterus 70 by 60 by 25 millimeters. Near the

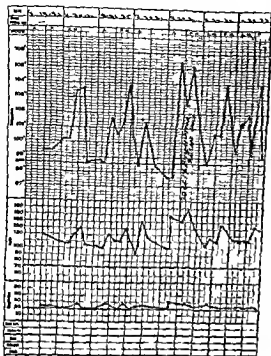


Fig. 1

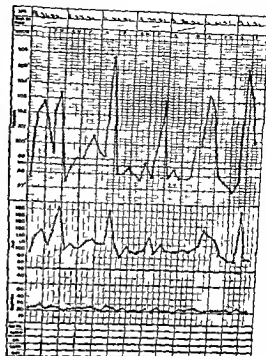


Fig. 2 to 5 Temperature pulse and

anterior horn are two ragged linear breaks in mucosa 8 and 12 millimeters in length. These lie side by side about 4 millimeters apart at one end and 10 millimeters apart at opposite end. Sections reveal two ruptures completely through the wall and mucosa the inner extremities being about 30 millimeters apart. These cracks have sides closely approximated but mottled creamy gray and dark bluish red covered with pots of blood and thin fibrinous exudate and apparently are pre-operative tears. The endometrial surface is spotted with blood clots. The muscularis elsewhere shows similar clefts which dip through the endometrium into the muscularis to varying depths but no others reach the serosa. The serosa appears at a little dull about breaks but otherwise is not remarkable.

Attached to the uterus is one ovulated 3 by 50 millimeters soft injected and tortuous. The lumen contains a small amount of bloody fluid.

**Microscopic description.** Uterus Section through the break in the myometrium shows a cleft away to the peritoneal side which is filled with blood clot and leucocytes. Along the surface of the break red blood cells infiltrate between muscle bundles where there are large numbers of infiltrating leucocytes including many polymorphonuclear and endothelial leucocytes. In the edges of the rupture in muscle there is considerable brownish black granular pigment much of it taken up by phagocyte. Deeper

in the muscle are clumps of leucocytes including polymorphonuclear endothelial and many lymphocytes and plasma cells. Through the endometrial wall there seems to be an increased amount of fibrous tissue.

**Endometrium.** The stroma is lensely infiltrated with leucocytes chiefly lymphocytes and plasma cells. No chorionic villi or decidua are seen.

**Ovulated.** Moderate round cell infiltration and some blood pigment deposit are present.

**Cross and microscopic diagnosis.** Complete multiple ruptures of uterine wall. Subacute myometritis. Chronic endometritis. Slight chronic salpingitis.

**Discussion.** The gross and microscopic appearance of the uterus shows a minimum amount of necrosis along the planes of ruptures with hemorrhage and cellular reaction to indicate injury and effort toward repair *in situ* prior to hysterectomy. It seems evident that the uterine cavity must have been very nearly if not quite sterile or more active reaction about the tears in the serosa would have been evident.

The more interesting features of the case are (1) the history of profuse bleeding and marked syncope which are important signs of rupture but they had failed to excite the

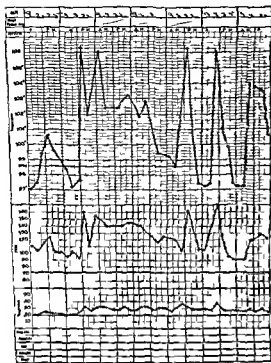


Fig 3

re piration charts in author cas

suspicion of this accident either on the part of the obstetrician at the time or myself subsequently (2) the absence of peritonitis as a result of the injury even in the presence of infection sufficient to produce violent systemic reaction and (3) the failure to obtain a culture of organisms from the blood. The explanation of this failure apparently lies in the fact that when the bacterial flora evidently of mild type in the uterine vessels elaborated sufficient toxin a violent reaction followed its entrance into the blood stream without the actual presence of the bacteria themselves.

The fourth point of importance appears in the recovery of this patient after the long delay during which expectant methods were employed before the radical hysterectomy was performed. The fact that she had received pituitrin during labor must be considered as one at least of the determining causes of rupture. It is perhaps the chief causative factor in this case.

This brings us to a study of the reported cases of rupture of the uterus following the

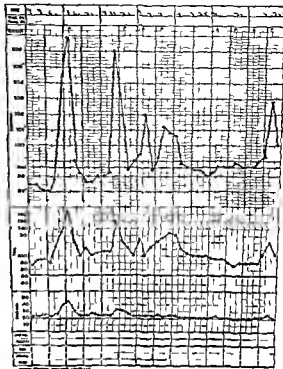


Fig 4

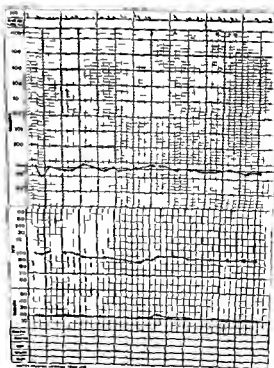


Fig 5



Fig. 6. Microscopic section of specimen

administration of pituitrin as well as of the question of rupture in general. Some of these cases appear to point to pituitrin as the actual exciting cause of rupture. It would be interesting to learn whether or not the percentage of cases of rupture is greater with the use of pituitrin. The number of cases however is too small for us to draw any conclusions upon this point.

A rather interesting study of the Dangers of Pituitary Extract has been made by C. C. Haskell and W. Pierce Rucker. Rucker states in another article that by means of a microventer with a mercury manometer he has been able to show the characteristic action of pituitrin upon the uterine muscle. He says: "It never gives contractions with periods of rest between but always a continuous series of contractions with increase in intra uterine pressure. This is shown by tracings even after the smallest dose. If his conclusions are correct it would appear that the tetanic contractions produced by the drug must be considered as important in the production of rupture in certain cases."

In the case recorded herein it seemed to the writer that the delay in recognition of this rupture was unusual but in looking over the literature we were able to find a case which was recorded by Dr. Rufus B. Hall in 1916. In this case the recognition of the accident took place at operation 49 days later. There was no recognition or evidence of any complication or febrile reaction until 5 days after delivery and rupture was not even suspected. The only evidence pointing to such a lesion was the statement made in Dr. Hall's closing discussion that she lost consciousness for 5 or 10 minutes and her husband who was a physician thought she had fainted. Recovery followed Dr. Hall's operation. No record is made of the administration of pituitrin in this case.

In discussing Dr. Hall's case Dr. S. J. Goodman, Columbus, Ohio, records a case which occurred in the service of Dr. Drury at Grant Hospital in which diagnosis was not made until a week after the rupture had taken place. He also mentions a second case which occurred in the service of Dr. Baldwin in which the diagnosis was made promptly by the attending physician and came to immediate operation. Both of these cases recovered.

Dr. Palmer Findley at the same meeting<sup>1</sup> in discussing the papers by Drs. Bell and Ronge on Rupture of the Uterus Following Cesarean Section records a case which he saw in the Charité Hospital in Berlin in the service of Professor Franz in which rupture occurred after the use of pituitrin.

My attention has been called to a report of two cases of rupture of the uterus one of which occurred 55 years ago in 1849 and the other in 1861 both recorded in the *Transactions of the West Virginia State Medical Association* 1868-1874 p. 619. In the first case the patient died before delivery could be accomplished.

The second patient was a woman aged 23 mother of two children whose previous labors had been normal. She presented a rupture of the uterus with the escape of a hydrocephalic child into the abdomen at full term of pregnancy. The head was perforated and the

child had been delivered by version 5½ days after rupture. The after treatment consisted of cleanliness, brandy, anodynes and profound rest. The patient was confined to bed and her room for about 4 months after delivery. Menstruation returned the fourth month after delivery.

In 130 labors in Dr Hupp's practice he saw two cases of rupture of the uterus. The latter record comes through a personal communication from Dr John C Hupp's son Dr Frank LeMoyné Hupp a distinguished member of this association.

McNeile's record is one case and cites 13 others in the literature in which rupture in the uterus occurred after the administration of pituitary extract with 13 maternal deaths.

|                   | Case      | Deaths    | R        |
|-------------------|-----------|-----------|----------|
| Reported by       |           |           |          |
| Mundell           | 7         | 0         |          |
| Herz              | 1         | 0         | 1        |
| Loeb              | 1         | 1         | 0        |
| McGinnis          | 1         | 1         | 0        |
| Zullig            | 5         | 4         | 1        |
| McNeile           | 1         | 0         | 1        |
| <b>Total</b>      | <b>16</b> | <b>13</b> | <b>3</b> |
| More recent cases |           |           |          |
| Bourne            | 1         | 1         | 0        |
| Dorland           | 1         | 1         | 0        |
| Marwell           | 1         | 1         | 0        |
| Phaneuf           | 2         | 1         | 1        |
| Wertensbaker      | 2         | 1         | 1        |
| <b>Sherrill</b>   | <b>7</b>  | <b>5</b>  | <b>2</b> |
| <b>Total</b>      | <b>1</b>  | <b>0</b>  | <b>1</b> |

It is not the purpose of this contribution to go into the many causes which result in rupture of the uterus. The use of pituitrin however is of considerable importance. Of the cases reported in which rupture has occurred after administration of this drug the conclusion seems justifiable that its use early in labor may be followed by rupture. Great caution therefore should be exercised in its therapeutic employment.

The case here recorded also shows that sudden collapse during the progress or at the completion of labor is of great diagnostic value and should at once suggest its occurrence. Uncontrollable hemorrhage after the delivery of the child and placenta should cause one to suspect rupture of the uterus.

either partial or complete. Inspection of the source of the hemorrhage should clear up the diagnosis.

The mortality in rupture of the uterus according to Schmauch ranges from 30 to 63 per cent. These figures compare favorably with the more recent reports of cases following the use of pituitary extract collected by McNeile which show a mortality of 83 per cent. The more recent cases including those of Bourne, Dorland, Maxwell, Phaneuf, Wertensbaker, Hall, Goodman (Drury and Baldwin), and Sherrill show 12 cases with 5 deaths.

The important causes of death are hemorrhage, shock, and sepsis. Many of these deaths are undoubtedly the result of ill advised or protracted efforts at delivery before the condition is recognized. It is evident that prompt recognition and surgical intervention will show marked decrease in the mortality.

The treatment of these cases at operation consists in suture of the torn uterus or in hysterectomy. When there is any doubt regarding the presence of infection removal of the uterus is preferable. In the absence of infection suture of the rent as in cesarean section may be employed. It does not appear in the light of advanced surgical technique that the employment of tamponade would be wise except in those cases in which competent surgical help cannot be obtained.

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Fig 6 Micrograph of pituitary

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McNeile, L. C. records one case and cites 13 others in the literature in which rupture in the uterus occurred after the administration of pituitary extract with 13 maternal deaths.

| Recorded by | Case | Death | By |
|-------------|------|-------|----|
| Mundell     | 7    | 7     | 0  |
| Herz        | 1    | 0     | 1  |
| Maher       | 1    | 1     | 0  |
| Huggin      | 1    | 1     | 0  |
| Zullig      | 5    | 4     | 1  |
| McNeile     | 1    | 0     | 1  |
| Total       | 16   | 13    | 3  |

#### More recent cases

|             |   |   |   |
|-------------|---|---|---|
| Louree      | 1 | 1 | 0 |
| Dorland     | 1 | 1 | 0 |
| Maxwell     | 1 | 1 | 0 |
| Phaneuf     | 2 | 1 | 1 |
| Wertenbaker | 2 | 1 | 1 |
|             | 7 | 5 | 2 |
| Sherrill    | 1 | 0 | 1 |

I n p l i n w g e

It is not the purpose of this contribution to go into the many causes which result in rupture of the uterus. The use of pituitrin however is of considerable importance. Of the cases reported in which rupture has occurred after administration of this drug the conclusion seems justifiable that its use early in labor may be followed by rupture. Great caution therefore should be exercised in its therapeutic employment.

The case here recorded also shows that sudden collapse during the progress or at the completion of labor is of great diagnostic value and should at once suggest its occurrence. Uncontrollable hemorrhage after the delivery of the child and placenta should cause one to suspect rupture of the uterus,

either partial or complete. Inspection of the source of the hemorrhage should clear up the diagnosis.

The mortality in rupture of the uterus according to Schmauch ranges from 30 to 63 per cent. These figures compare favorably with the more recent reports of cases following the use of pituitary extract collected by McNeile which show a mortality of 83 per cent. The more recent cases including those of Bourne, Dorland, Maxwell, Phaneuf, Wertenbaker, Hall, Goodman (Drury and Baldwin) and Sherrill show 12 cases with 3 deaths.

The important causes of death are hemorrhage, shock, and sepsis. Many of these deaths are undoubtedly the result of ill advised or protracted efforts at delivery before the condition is recognized. It is evident that prompt recognition and surgical intervention will show marked decrease in the mortality.

The treatment of these cases at operation consists in suture of the torn uterus or in hysterectomy. When there is any doubt regarding the presence of infection removal of the uterus is preferable. In the absence of infection suture of the rent as in cesarean section may be employed. It does not appear in the light of advanced surgical technique that the employment of tamponade would be wise except in those cases in which competent surgical help cannot be obtained.

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EXOPHTHALMIC GOITER IN THE PACIFIC NORTHWEST<sup>1</sup>By J. TATE MASON, M.D., F.A.C.S., SEATTLE, WASHINGTON  
From the Mason Club.

GOITER is one of the great problems in the state of Washington. It has been estimated that 65 per cent of the boys and 75 per cent of the girls between the ages of 12 and 18 have some enlargement of the thyroid gland. There are districts east of the Cascade Mountains along the valleys and especially in the region drained by the Methow River in which all the domestic animals have some disturbance of the thyroid. In this district we find hairless pigs and goats and also weakness in the new born foals. Until it became a routine practice to administer iodine the Indians and dogs were the only living things that escaped serious damage. The Indian obtained a considerable amount of iodine from stripped salmon which is one of his chief foods and the dog evidently received a certain amount of iodine from the same source.

From these regions especially and from the state as a whole we see a large percentage of exophthalmic goiter in later life. While there is no proof that adolescent goiter predisposes to exophthalmic goiter it seems probable that once the internal secretions of the gland have been disturbed there remains an instability which later in life may cause a toxic hyperplastic goiter.

Exophthalmic goiter with few exceptions runs a typical course and while the administration of iodine diminishes the toxic symptoms so markedly that they are often rather difficult to recognize still they are present. There is a gradual increase in the severity of the symptoms until about the eighth month when the condition becomes markedly worse (Fig. 1). At about the ninth month there is an explosion of symptoms commonly known as the crisis. Then there is a period of improvement with fairly constant symptoms. About the end of the second year a second crisis occurs which is never quite so severe from the standpoint of toxicity as is the first.

We have for some years endeavored to classify exophthalmic goiter in a workable

way. This was attempted so that internist, surgeon, laryngologist, nurse and everyone concerned with the case might understand about what was to be expected as to severity of illness in each individual. Clinically this classification embraces four stages.

In the first stage we have the patients who are seen very early after 6 or 8 weeks when at times diagnosis is difficult because no specific criteria can be fixed as to when normal function of the gland ended and hyperthyroidism began. This stage is designated as the *early exophthalmic*.

In the second stage we have the patients who came for examination later 1 to 2 months before the crisis occurs. In them we find pronounced and progressive toxemia, loss of weight, rapid pulse and a high basal metabolic rate. This stage is designated as *acute ascending exophthalmic*.

In the third stage we have the patients who have reached the crisis. From the standpoint of toxemia the gland is giving off its maximum amount for that particular case. Some of these fully developed cases are not extremely ill; in others the condition is characterized by cardiac decompensation, vomiting, acidosis, prostration and delirium and sometimes the patient dies. This syndrome is designated as the *crisis*.

In the fourth stage we have the patients who have been ill for some years. In them we find marked exophthalmos and some bronzing of the skin. The basal metabolic rate is always plus but it never runs very high. Usually these patients carry on their work with difficulty no matter how light it may be. Compared with their former state of illness their present condition is very bad. These we have designated as *late exophthalmic* or *educated gland cases*.

There are two classes of patients with exophthalmic goiter who require a great deal of care and observation. The first class includes young girls who develop the disease and become rapidly worse so that they may die



Fig. 1. Usual course of exophthalmic goiter. The black line represents the normal health line.

promptly in an explosion of hyperthyroidism so violent that not all the classical symptoms may develop. The patient may have no exophthalmos, relatively little goiter, occasionally little tremor, but very marked prostration, weakness, vomiting, nervous symptoms, and extremely bad pulse. The second class includes patients in the forties or beyond who develop the disease rather suddenly and who do not present appreciable enlargement of the thyroid gland. They may become ill so rapidly that we must assume either a very poor resistance to the disease on the part of the patient or that the toxemia is extremely grave. Skin pigmentation, sometimes so marked as to suggest Addison's disease, is particularly prone to occur in this group. The goiter is small and on palpation is hard. In these cases it is often extremely difficult to make a diagnosis. The microscopic picture, however, is typically that of exophthalmic goiter. In each case we have studied we have found very rapid weight loss, tremor, and irritability, rapid heart action, marked loss in strength, and no exophthalmos.

In this group are included some very bad risks and each patient has had to be handled with extreme care after the diagnosis was made. The basal metabolic test always showed a high rate in such patients and the medical death rate was high.

With rare exceptions the clinical symptoms subsided so readily following the administration of large doses of iodine that an investigation was undertaken for the purpose of studying any possible change in the pathological picture of the gland after treatment. Examination of a large number of these glands demonstrated that change does occur, as in

each case there was noted a large deposit of colloid material which seemed to press the cells against the supporting framework of the acini. As there is no duct through which to discharge the secretions of the gland, the absorption of thyroxin is by the lymph vessels or blood stream.

Plummer (6), Kendall (4), and Boothby (1) believe that there is in exophthalmic goiter a catalytic action of thyroxin and that this causes the syndrome. When iodine is administered this active principle of thyroxin receives another molecule which is needed to change it to normal thyroxin.

We have entertained the thought that possibly the outpouring of the colloidal material in the acini following iodine therapy might cause a mechanical obstruction to the lymph and blood supply which would in a very diminished the absorption of this material. In the gland of exophthalmic goiter we find the acini small before the administration of iodine and the cells are large and of the columnar type. In a very short time after the administration of Lugol's solution we find the acini large and filled with colloid material.

In July 1923 a patient whom we considered just on the verge of crisis—a very extreme case of exophthalmic goiter presented himself to the clinic. After a few days treatment with Lugol's solution he became much better but was dissatisfied with his surroundings and demanded that something be done without a prolonged stay in the hospital. Feeling that it would be best for the patient because of his mental attitude to act we ligated one pole. At this ligation a small piece of thyroid about one half centimeter in diameter was removed. Under the microscope this piece presented the picture typical of exophthalmic goiter (Figs 2 and 3). The patient was then kept in bed for 6 weeks with forced feeding and large doses of Lugol's solution. At the end of that time he had developed an iodine rash. His mental condition was clear and there was marked diminution of his hyperthyroidism. A partial thyroidectomy was done. The microscope showed large acini filled with colloid material and instead of columnar epithelium lining the walls, cuboidal epithelium was found and very little hyper-



Fig. 2

Fig. 3

Fig. 4

Fig. 2 Low power Exophthalmic goiter showing hyperplasia and very little colloid Before iodine therapy

Fig. 3 High power Same as figure Hyperplasia tall

columnar epithelium pyknotic nuclei and very little colloid

Fig. 4 Low power Colloid goiter Same gland shown in figure But after 6 weeks iodine therapy

plasia (Fig. 4). In other words microscopically we were looking at a colloid goiter and not at a hyperplasia such as had been present in the same gland 6 weeks earlier. This change in the thyroid gland seen after prolonged iodine administration is the same involution described by Cattell (1) and Reinhold (7).

Knowing the effect produced upon exophthalmic goiter by Lugol's solution we made a study of the results of administering the drug to dogs with normal thyroids. For this purpose large healthy dogs were secured. Under aseptic precaution a small piece of thyroid hypertrophy following partial excision the blood supply was not disturbed (3). Grossly the glands were normal thyroid glands of a dog. Recovery from operation was uneventful. Administration of Lugol's solution 10 minims twice a day was begun the following day. The solution was given in capsules for a period of 20 days. Except for slight diarrheas the dogs were healthy during this time. The second operation was then performed. The entire gland of each dog being removed. Grossly these glands removed at the second operation presented the picture of a colloid goiter. They were friable, glossy, and upon section translucent with a shiny, brownish red appearance. It seemed as though one could see into the gland substance. On pressure there exuded a thick viscid colloid material. Microscopically sections of pieces of glands removed prior to iodine medication were essentially normal thyroids for the dog (Fig. 5). The general

picture suggested a slight hyperplasia as is seen in the exophthalmic goiter. There was only a slight amount of colloid in the gland of one dog.

Study of the glands removed from the dogs after iodine administration revealed characteristic colloid goiter: large acini, some cystic, with single rows of cuboidal epithelium lining them and all filled with an abundance of colloid material (Fig. 6).

In some further experiments we found that 15 drops of Lugol's solution taken on an empty stomach by a normal individual will show in the saliva in about 11 minutes. In a patient with a hyperfunctioning thyroid we find that the solution comes through in from 18 to 26 minutes. We have not had enough experience with this, however, to make this statement.



Fig. 5

Fig. 6

Fig. 5 Low power Normal thyroid of dog Before iodine therapy Very little colloid

Fig. 6 Low power Same gland as shown in Figure 5 After iodine therapy for 26 days Marked increase in colloid



# CATHETERIZATION OF THE EJACULATORY DUCTS

By HARRY C. ROLNICK, M.D. CHICAGO

CATHETERIZATION of the ejaculatory ducts is a therapeutic and diagnostic procedure which when successfully performed may be of considerable benefit. Strictures of the ejaculatory duct can be dilated and better drainage of the infected seminal vesicle thus permitted the closed ejaculatory duct may be restored to patency the infected seminal vesicle can be medicated and fluid may in some instances be forced into the ampulla of the vas deferens. Under favorable conditions the entire vas deferens and the tail of the epididymis may also be injected and in this way it may be possible to locate strictures of the vas deferens determine the patency of the epididymis and outline the seminal vesicle to determine pathological changes (7).

The danger of epididymitis following the injection of an antiseptic into the seminal vesicles and ampulla is slight. Following vasotomy some of the solution regurgitates into the epididymis however an immediate chemical epididymitis is never seen. I have shown recently that no fluid can be forced beyond the tail of the epididymis (4). Any solution injected if not too irritating will be rapidly expelled by the peristaltic action of the epididymis and vas without injury to these structures. Epididymitis that frequently follows manipulation of the verumontanum and ejaculatory ducts in catheterization is the result of trauma. Edema with occlusion of the duct due to trauma prevents drainage of the vesicle and epididymitis develops.

Despite the fact that the ejaculatory ducts offer a relatively safe and ideal route and direct anatomical approach to the seminal vesicles catheterization of the ducts and injection of the seminal vesicles is successful in only a limited number of cases. Urologists possessing a fair degree of skill are only occasionally successful in catheterizing the ducts. The difficulties encountered in attempting to catheterize the ducts can be stated.

The openings of the ducts are in most instances so small that they cannot be seen either through the endoscope or cystourethroscope. Belfield injected milk through the vas deferens into the vesicle and then stripped the vesicle with the endoscope in place. He was able to locate the ducts by noting the point of exit of expressed contents. Luys has done the same with boric acid solution (3). The mouths of the ducts are found more frequently on the lips of the utricle than on each side on the verumontanum as usually described (5). Therefore it is difficult to insert an instrument even when the ducts are visible. The ducts often open on the inner lip of the utricle. In some cases they may be found on the floor of the utricle with the result that catheterization is practically impossible. Anomalies in location are also frequent. Distortion or atrophy of the verumontanum as the result of a posterior urethritis will usually make it impossible to locate the ducts.

When a catheter or needle has been inserted into the duct it will usually travel but a short distance. The ejaculatory duct is tortuous runs forward and downward and the catheter cannot often be successfully manipulated to allow for its passage into the seminal vesicle. In most cases in which it is thought that the catheter has entered the vesicle it will be found if the cystoscope is advanced toward the bladder that the catheter has torn through the verumontanum and has entered the bladder.

With considerable practice in the hands of a few catheterization of the ducts has been found successful and has been adopted and recommended as the route for direct medication in infections of the seminal vesicles.

Fuller and Luys (3) have shown that a stylet or wire inserted through the ejaculatory duct always enters the seminal vesicle and not the ampulla of the vas deferens. To insert a needle into the ampulla requires considerable manipulation and is always a blind

definite at present. From our conception of what iodine means to the hyperplastic goiter these observations are probably correct. The gland is low in iodine and every cell in the body is in need of it. Marine has shown that the amount of a given intake absorbed depends for the most part on the size of the gland and the existing degree of hyperplasia or the degree of saturation with iodine at the time of its administration (5).

The test for iodine is a very simple one. A test tube is partly filled with starch paste and one drop of dilute ferric chloride and one drop of dilute hydrochloric acid are added. A small amount of saliva is transferred from the patient's mouth to the test tube and immediately an orange color appears if iodine is present in the saliva (1).

We feel certain that every patient under treatment should have an overflow of iodine in the saliva enough to give a decided orange

color on testing. Not until then is the patient getting enough iodine.

We have great hopes for the elimination of thyroid disease in the future. A gland with a high iodine content rarely has disturbed function. The water in this Northwest country is low in iodine and the people are gradually learning this fact. When those in charge of the water supply of municipalities and country districts have realized this deficiency and have acted, not only will exophthalmic goiter gradually disappear but the other types as well.

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FIG. 3. Another postmortem specimen. The sheath of the seminal vesicle and ampulla of one side has been injected showing that contrast fluid has been forced quite a distance along its sheath. This specimen was reported in another series of experiments appearing in the *Journal of Urology*, October, 1925. The seminal vesicle of the other side has been injected through the ejaculatory duct. No fluid could be forced into the ampulla.

FIG. 4. Both vesicles have been injected and overdistended. The ampulla of the vas deferens on one side shows that fluid has entered; the other side could not be injected.

from which the bladder, prostate, posterior urethra, seminal vesicles, seminal ducts, and testicles were removed in toto.

The ejaculatory ducts could not be located with the naked eye in most of the specimens. In order to insert a needle into the duct it was necessary in most cases to strip the vesicles and note the point of exit of the vesicular contents. The openings of the ducts were found to be on the lips of the utricle in the majority of the specimens. In a few they were on the inner lip of the utricle and in two they were found within at its base.

When the attempt was made to enter the vesicle by manipulating the needle, the duct was torn through in a few instances and the point of the needle made its exit in the upper part of the verumontanum. A long needle was used and usually inserted into the seminal

vesicle. Distention of the vesicles always resulted in the regurgitation of the fluid alongside the needle into the posterior urethra. In only 8 instances was it possible to force fluid into the ampulla of the vas deferens. In all the others following repeated distention and manipulation of the needle, fluid injected regurgitated alongside the needle without being forced into the ampulla. An attempt to locate the ampulla of the vas deferens with the needle was a blind maneuver and as stated above usually unsuccessful.

In these experiments a 50 per cent sodium iodide or bromide solution was injected and roentgenograms were made to determine whether the fluid had passed beyond the seminal vesicle. The illustration showing the epididymis injected was an anomaly which does not figure in the series of cases in this study; the vesicle communicated directly with the vas. However, in only 8 of the 58 injections was it possible to force fluid beyond the vesicle.

These results were had in postmortem specimens in which many of the difficulties encountered in the living are not met.





Fig. 1 Fresh postmortem specimen of the bladder prostate, urethra, seminal ducts and testicles removed in toto. Contrast fluid consisting of 50 per cent sodium bromide was injected through the ejaculatory duct into the seminal vesicle of each side. The seminal vesicles were overdistended with the fluid. Roentgenogram shows the vesicles and also demonstrates that no fluid could be injected into the ampulla of the vas deferens.

procedure. Any fluid injected into the vesicle is prevented from entering the vas by the tonic closure of the ampulla. When the vesicle is overdistended the fluid will in most instances kick back alongside the needle into the posterior urethra. Belfield (2) was the first to demonstrate on the living a sphincter whose contraction closes the orifices of the ampulla and vesicles. This fact explained why fluids injected through the vas deferens distend the vesicle before escaping through the ejaculatory duct. The ampulla of the vas inserts itself somewhat obliquely into the neck of the seminal vesicle. This insertion is similar to that of the ureter into the bladder. The ampulla and vesicle do not join to form the ejaculatory duct as is generally believed. The ejaculatory duct is continuous with the seminal vesicle but not with the ampulla which enters the seminal vesicle higher up.

The ampulla of the vas deferens remains closed when the seminal vesicle is distended



Fig. 2 Specimen similar to No. 1 injected in same manner. The seminal vesicles are distended but no fluid could be forced into the ampulla. The dark shadow along the course of the vas deferens near the testis shows the sheath injected employed in another series of experiments also reported.

just as does the ureter when the urinary bladder is filled. And as is true of the ureter where occasionally reflux will occur following distention of the urinary bladder reflux will manifest itself up the vas deferens in a few cases when the seminal bladder is overdistended. It is important to remember that in infections of the seminal vesicle the ampulla of the vas deferens is equally involved in the pathological process (1). Any procedure for treating the seminal vesicles must include treatment of the ampulla of the vas deferens. Sterilization of the seminal vesicle alone will not cure the patient.

Young (7) recognizing the necessity for sterilizing the ampulla as well as the vesicle employs a long needle which is kept near the median line and manipulated into the ampulla. This is a blind procedure and can be successful only occasionally.

It is thus seen that because of the difficulty of injecting the ampulla of the vas deferens medication of the seminal vesicles by way of the ejaculatory ducts is usually a failure.

The observations from which I have drawn my conclusions were made in living patients and in a series of 9 freshly posted cadavers.

# INTRA-ABDOMINAL HÆMORRHAGE OF OVARIAN ORIGIN<sup>1</sup>

By DAVID STEINER M.D. BROOKLYN, NEW YORK

American College of Obstetrics and Gynecology, New York City

IT is evident from the gradual accumulation of cases of ovarian hæmorrhage recently reported in the literature that this condition is not so rare as we have hitherto been led to believe in fact the frequency of this accident and its gravity warrant the consideration of bleeding from a follicular cyst or from a corpus luteum cyst of the ovary with rupture in making a differential diagnosis. This is particularly true inasmuch as a correct diagnosis is rarely made before operation.

The debatable etiology and uncertain pathology of ovarian hæmorrhage leave this condition still an obscure problem requiring additional study for its explanation. The predisposing factors have been summed up by Stein (8) as follows:

## Local

- 1 Menstrual (excessive menstrual hyperemia)
- 2 Non menstrual
  - a Active hyperemia as acute or chronic oophoritis
  - b Passive hyperemia as thrombosis of vein
  - c Primary or secondary neoplasm
  - d Trauma, excessive coitus, etc.

## General

- 1 Diseases altering composition of blood
  - a General disorders of nutrition as anemia or chlorosis
  - b Hemophilia
  - c Infectious diseases as typhoid, acute exanthemata, etc.
- 2 Phosphorus poisoning
- 3 Venous congestion of abdominal viscera as in heart or lung disease

Phaneuf (5) divides ovarian hæmatomata into three types:

1 The large ovarian cysts with hæmorrhagic contents due to twisting of the pedicle of the cyst or other conditions.

2 The perforating hæmorrhagic (chocolate) cysts of the ovary as described by Sampson.

3 The follicular and corpus luteum cysts of the ovary which on rupture may result in severe intraperitoneal hæmorrhage.

The first two groups as a rule give rise to comparatively little intra abdominal bleeding.

Wolf (9) divides ovarian hæmorrhage into three types: (1) interstitial (2) follicular (3) intrafollicular.

Pfannenstiel (4) is of the opinion that these three varieties have no practical difference, one type running into the other in fact all three may be present in the same ovary.

Savage (6) groups his cases into hæmatoma of the graafian follicle and hæmatoma of the corpus luteum with the microscopical findings as follows:

In the first group he observed that in places the wall of the hæmatoma was lined with a single layer of epithelium representing the membrana granulosa lying on a basement membrane and external to this two strata of cells which he regarded as the theca externa and interna. Both strata were vascularized especially the latter. The cells of the inner layer showed early lutein formation. In the second group hæmatoma of the corpus luteum he found that there was an outer shell of ovarian tissue which showed moderate congestion. The inner part of the wall showed newly formed fibrous tissue poor in cells. Near the lining in between the longitudinal strands of tissue there were blood extravasations many round cells and many large rounded cuboidal cells containing coarse yellow granules. The nuclei of these cells were relatively small and in many instances seemed to be crowded toward the periphery of the cell.

Savage is of the opinion that hæmorrhage into the stroma is secondary to hæmorrhage within the follicle the blood escaping from the latter when the tension ruptures the wall.

On the other hand Novak (7) believes that the primary source of the bleeding is the perfollicular vascular wreath from which it



# INTRA-ABDOMINAL HÆMORRHAGE OF OVARIAN ORIGIN<sup>1</sup>

By DAVID FEINER M.D. BROOKLYN, NEW YORK

A. Acad. Cycol. t. 110. t. 1. in B. th. M. 11. 17. Hosp. t. 1. Ab. et P. th. 1. t. B. th. M. 11. p. th. 1.

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Fig. 5. The seminal vesicles, ampulla and most of the vas deferens of one side after contrast injection. This experiment demonstrates the possibility of radiography of the permathe duct. The other side shows ampulla partially injected.



Fig. 6. In an animal in which the seminal vesicle on one side was rudimentary and communicated directly with the vas deferens. The entire vas deferens and tail of the epididymis are visible. This demonstrates the possibility of radiography of the seminal ducts.

### SUMMARY

By injection of the seminal vesicles through the ejaculatory ducts it was possible to force fluid into the vas deferens in only 8 of the 58 injections made in 9 postmortem specimens.

The ejaculatory ducts were so small in most instances that it was impossible to locate them until the seminal vesicle was expressed.

The ampulla of the vas deferens was located through the ejaculatory duct with difficulty in a small number of cases.

### CONCLUSIONS

Catheterization of the ejaculatory ducts is a difficult procedure; most attempts fail.

Fluid injected through the ejaculatory duct reaches the seminal vesicle first and not the ampulla of the vas.

The ampulla of the vas deferens does not communicate directly with the ejaculatory duct; it enters the neck of the seminal vesicle.

It is not possible except in a small number of cases to force fluid beyond the seminal vesicle into the ampulla through the ejaculatory duct. Manipulations designed to insert a needle into the vas deferens usually fail and are at best blind maneuvers.

Medication of the seminal vesicles through the ejaculatory ducts seldom accomplishes its purpose for the ampulla of the vas deferens which is always equally involved in the pathological process can be injected in only a limited number of cases.

I am indebted to Dr. Harry Surge, pathologist of Cook County Hospital for a course of the technique in furnishing me with the specimen used in these experiments.

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Ovarian hæmorrhage may occur at any time from birth until the menopause, but it rarely happens after that unless there is an ovarian growth. The amount of bleeding varies greatly, as indicated in the summary of Novak. He speaks of the small amount of blood lost namely two tablespoons in the cases reported by Armun Mueller and others while the patients of Buerger and Cohen each lost 2 liters of blood, and in Peuch's case a loss of 3 pints resulted in a fatal termination.

The following is a typical case of bleeding from a ruptured corpus luteum.

A P. Italian age 19 married 2 months was referred to the Beth Moses Hospital November 17, 1924 by Dr. Nathan Slutsky through whose courtesy I was called to see the patient. She had been taken ill quite suddenly with sharp pains in the lower abdomen 3 days prior to admission most marked on the right side not radiating and lasting 2 hours. The pain then subsided until the day of admission when she was seized with severe pain across the lower abdomen vomited a little and practically collapsed.

The family history was negative. Previous history showed that she had had lung trouble in 1917 and was in a sanitarium for 3½ years. She was discharged as an arrested case. Menstruation began at 14 was of 30 day type and of 5 days duration flow was profuse. She had premenstrual dysmenorrhœa and occasionally skipped a period. Previous last regular menstrual period was October 19. She began to bleed on afternoon of admission.

Examination revealed a rather poorly nourished young woman acutely ill. The lungs showed involvement of the left apex with many moist crackling râles. The abdomen was rigid and tender over the lower half with peritoneal rebound. Vaginally there was an exquisitely sensitive cervix with a soft doughy mass in the cul-de-sac. Further examination of adnexa was unsatisfactory because of extreme tenderness. The temperature was 99 degrees pulse 90 red blood cells 4,100,000 hæmoglobin 70 white blood cells 13,000 polymorphonuclears 80 per cent. With these findings a diagnosis of ruptured tubal pregnancy was made.

The abdomen was opened by a median incision (Feiner Slutsky). Upon dividing the peritoneum there was revealed a massive hæmorrhage and on inspection the right ovary was found to be the source of the bleeding, a small rent in the rip corpus luteum being apparent on its superior aspect. A tiny blood clot was partially extruded from the point of rupture while the opening and the cavity to which it led was filled with clots. The right ovary was removed and the abdomen closed in the usual manner. Convalescence was uneventful and the patient left the hospital 23 days after operation.

**Pathological findings.** Gross examination shows that the ovary measures 5 centimeters by 4 centimeters by 3½ centimeters. On cross section there is revealed a well developed corpus luteum 2 centimeters in diameter and many microcysts. Microscopical examination reveals a corpus luteum in stage of vascularization. Of particular significance as a potent participating factor in the hæmorrhagic tendency of this ovary is the presence of a large number of blood sinuses immediately adjacent to and surrounding the corpus luteum. The walls of these sinuses are made up of a single layer of elongated endothelial cells accounting for their friability and are filled with red blood cells. Scattered throughout the ovary are numerous atretic follicles showing the usual structure of follicle cysts. The ovarian hypertrophy is due to a hyperplasia of the ovarian stroma.

The second case which I am reporting through the courtesy of Dr. H. Rabinowitz represents a group occurring in girls of adolescent age during one of their early menstrual periods. Schumann considers that such ovarian hæmorrhages are more or less functional errors that is they are the result of an excess of bleeding from the wall of the mature graafian follicle in the adolescent ovary and there is no demonstrable morphological change present in the tissues.

M. M. age 14 was admitted to Beth Moses Hospital complaining chiefly of pain in the right lower quadrant. Three hours before admission patient had an acute onset of cramp like pains in right iliac region severe for a half hour then diminishing to be present only on pressure accompanied by nausea and vomiting. Patient has always been well.

Menstruation began at 13 was of 28 day type (was irregular coming every 30 to 40 days) of 5 to 6 days duration. She had to go to bed during last period which came 1 week early, 6 days previous to admission. Examination revealed a robust well developed girl in severe pain. The abdomen was rigid and tender over the right lower quadrant with some tenderness over the left lower quadrant. No masses were felt. Rectal examination showed a small ante flexed uterus. Nothing definite could be made out in the region of the adnexa on account of the pain. Pre operative diagnosis acute appendicitis. Temperature 100 degrees pulse 90 red blood cells 3,500,000 hæmoglobin 65 per cent white blood cells 11,000 polymorphonuclears 72 per cent.

The abdomen was opened by a right rectus incision (Rabinowitz). The bluish shimmer through the peritoneum indicated an intraperitoneal hæmorrhage. The peritoneum was divided and a large quantity of blood escaped. Further exploration



Fig. 1 Cross section of ovary of first case, showing corpus luteum with point of perforation of atretic follicles

breaks into the follicle. It is the consensus of opinion that true stromal hemorrhage is rare.

Boyce (1) makes the statement that no other organ in the body is so frequently the seat of hemorrhage as is the ovary, and Schumann therefore concludes that there must be a varied and somewhat vague morphological basis on which to account for the bleeding. The latter reports the pathological findings in one of the cases studied by him as a marked proliferation of the normal perfollicular vessels with an excessive degenerative arteritis of the vessels.

Schumann (7) likewise sums up the symptomatology and the clinical picture simply as that characteristic of sudden intraperito-



Fig. 3 Gross section made from slice of ovary of third case. Hematoxylin-eosin stain of ovarian capsule of ovarian stroma of ovarian hemorrhage perforation

neal hemorrhage, more or less profuse and usually associated with acute pain in one or the other iliac fossa. In a few cases the initial pain is entirely absent, distress being apparent only when the irritating effect of the free blood in the peritoneal cavity produces the characteristic dull generalized abdominal ache. There follows usually some dizziness with signs of shock and severe blood loss or the sthenic reaction of elevation of temperature, moderate leucocytosis, rectus rigidity and in general the syndrome of the acute abdomen. Rectal or vaginal abdominal examination will show an enlarged tender ovary or a tender doughy mass which is produced by the presence of blood inflammatory reaction and adhesions.

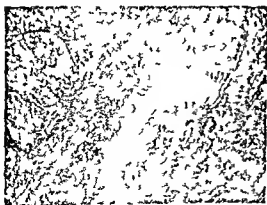


Fig. 2 Microscopical picture of area indicated by X in Figure 1, showing lutein cells on the left side. Blood in center of field.



Fig. 4 Microscopical picture of ovary of third case showing dense hemorrhagic infiltration.

## THE END-RESULTS OF MEDICALLY TREATED PEPTIC ULCER

By NOBLE WILEY JONES M.D. PORTLAND OREGON  
From the Department of Medicine, University of Oregon School of Medicine

WHAT are the results of the medical treatment of peptic ulcer? What is the percentage of permanent cure and the percentage of failure? What constitutes a cure and what type of peptic ulcer should be considered amenable to medical management? How should the patient be studied to determine his probable response to treatment?

A search through the current literature on the subject of peptic ulcer does not yield accurate information on these points. There is at the present time a great difference of opinion on the part of those who have published their views. It is quite evident that different writers have formulated their opinions in different ways. In some instances there is lack of sufficiently accurate records to justify conclusions as to end results.

Friedenwald (3) in 1919 gives the percentage of cure from the use of the Leube diet as 74, from the Lénhartz diet as 66 and from the Sippy diet as 86. Shattuck (5) in 1921 reports the end results from 28 cases of peptic ulcer observed from 6 months to 2 years. Of these 6 were gastric ulcers and 22 were ulcers of the duodenum. Twenty two of the total number of patients remained during these periods of observation free from symptoms. Five of the 6 gastric ulcer cases showed a disappearance under treatment of the ulcer niche. Eighteen of the 22 duodenal ulcer cases showed various responses. Diamond (1) in 1922 reports a series of 14 cases of gastric ulcer which remained cured for 4 years a 100 per cent record. His definition of healing consisted of (a) freedom from symptoms (b) disappearance of the niche and (c) the passing of peristaltic waves over the former site of the ulcer. No one has reported such results before or since to my knowledge. Nielsen (4) in 1923 is much less optimistic. He states that in his experience with the medical treatment of ulcer 60 per cent of patients having symptoms for 6 months or less remained cured. If symptoms had existed

from 3 to 5 years, only 20 per cent remained cured and if symptoms had been of longer duration very few were healed. Forsyth (2) in 1924 writing on the end result reports of medically treated ulcer in England from an insurance risk standpoint speaks of the very great uncertainty of the end results. Smithies (6) in 1925, claims the cessation of the ulcer process in 361 patients from a total of 470 or 77 per cent. This is a very large series of patients to follow carefully through a number of years and my own experience would cause me to expect that an intensive study of the progress of these patients would bring about a considerable lowering of the end result figures.

It is evident that from such recorded statements little but confusion arises. The same variance of experience is found in the literature of previous years. It was with the idea of obtaining more conclusive end result data for my own guidance that I began five years ago to collect the evidence from the cases tabulated below. Certain requirements for a proper selection of cases were laid down. First the clinical diagnosis required the presence of an ulcer niche, signs of activity as shown by regional spasm and local tenderness and a corroborative subjective history. Second only those cases which on examination appeared to be free from complications were included in the group that is cases with ulcer showing evidence of perforation of obstruction or showing the suspicion of malignancy or cases in which an associated inflamed appendix or gall bladder disease could be determined were excluded. Third, all patients were placed in hospital under rigid control and were considered under probation for the first 10 days or 2 weeks. All determined foci of infection were removed. Fluoroscopic examinations were made every 5 or 6 days to determine if possible whether the passing of local tenderness or spasm and the flattening out of the niche might justify the belief that healing was



revealed the source of bleeding to be a small rent in a follicular cyst the size of an almond on the inferior aspect of the left ovary. Here likewise the point of perforation with the cyst cavity was filled with small clots. The appendix showed no gross pathology. The ovary was resected the cystic portion being excised, the abdomen was closed in layers. The convalescence was smooth and uneventful. Microscopical examination of the specimen showed the usual structure of an atretic follicle clinically designated as a follicular cyst. No evidence of endometrial implant.

The following case which I am reporting through the courtesy of Dr. M. R. Robinson, exemplifies that group in which a twisted ovarian cyst may give rise to intraperitoneal bleeding.

J. G. age 23 married 14 months was referred to Dr. Robinson by her family physician with a presumptive diagnosis of ruptured tubal pregnancy. Her chief complaint on admission to the Beth Moses Hospital was pain in the left lower quadrant and some irregularity in her menstrual periods. The family history was negative. Menstruation began at 14 and was irregular. She menstruated at intervals of 1 to 2 years up to the age of 17 since then she has varied from 6 to 8 weeks with pre and co dysmenorrhea one half day before and the first day of the flow duration 6 days last period 6 weeks previous to admission. Present history shows that the patient had had occasional mild attacks of pain in the left lower quadrant. The day before admission she was suddenly seized with severe cramp-like pains in the left lower abdomen which required hypodermic medication for relief. A feeling of soreness over the entire lower abdomen has persisted up to the time of admission. On examination the abdomen was found to be tender and spastic in the left lower quadrant. Bimanual examination revealed the presence of a tender cystic mass the size of an orange in the region of the left adnexa. Red blood cells 4,000,000 haemoglobin 76 per cent white blood cells 10,000 polymorphonuclears 76 per cent. The pre-operative diagnosis was twisted ovarian cyst.

**Operation.** The abdomen was entered by a median incision (Robinson). The bluish shimmer through the peritoneum suggested an intraperitoneal hemorrhage and recalled the first physician's diagnosis of ectopic pregnancy which now appeared

to be confirmed. The peritoneum was incised and a considerable quantity of liquid blood escaped. Further exploration revealed the source of bleeding to be a small rent in a left ovarian cyst the size of an orange which had undergone strangulation as a result of two complete twists of the pedicle. The color varied from gray to black some areas appearing almost gangrenous. The point of rupture with its ragged edges presented a blown out appearance. The left tube was likewise distended purplish in color cystic in consistency, and suggested a possible tubal pregnancy. The uterus was small the right adnexa negative. The left tube and ovary were removed the abdomen closed in the usual fashion. The patient left the hospital on the fourteenth day after operation the convalescence being uneventful.

Microscopic examination of a section from the ovary showed a dense hemorrhagic infiltration throughout obliterating the ovarian structure. Examination of a section from the tube showed a diffuse hemorrhagic infiltration with no evidence of chorionic villi or syncytium.

These cases have been reported as a group, not only because of their intrinsic clinical interest but for the reason that they represent a distinct surgical entity the possibility of which should be considered whenever we are called upon to unravel the mysteries of an acute abdomen.

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## END RESULTS OF MEDICALLY TREATED PEPTIC ULCER

| Number | Local     | D rat f<br>Sympt ms | D rat f<br>Tr tm t | Tim e<br>T e tm at | H led<br>N ill l d<br>+ D fecit | Rel ps d<br>+ o | Re lt<br>+ o |
|--------|-----------|---------------------|--------------------|--------------------|---------------------------------|-----------------|--------------|
| 1029   | Duodenum  | 6 months            | 1 1/4 years        | 1 1/2 years        | +                               | o               | +            |
| 3580   | Duodenum  | 9 months            | 6 months           | 1 year             | +                               | o               | +            |
| 4332   | Duodenum  | 2 weeks             | 4 months           | 1 year             |                                 | +               | +            |
| 1040   | Duodenum  | 3-4 months          | 6-7 months         | 3 years            | o                               | o               | +            |
| 1697   | Duodenum  | 10 days             | 15 months          | 1 1/2 years        | o                               | o               | +            |
| 1892   | Duodenum  | 4 months            | 1 year             | 1 1/2 years        | +                               | +               | o            |
| 1759   | Duodenum  | 4 months            | 6 months           | 3 years            | +                               | o               | +            |
| 3469   | Duodenum  | 6 months            | 6 months           | 2 years            | +                               | o               | +            |
| 4919   | Duodenum  | 3 months            | 6 months           | 5 years            | o                               | o               | +            |
| 3180   | Duodenum  | 3-4 years           | 4 months           | 1 year             | +                               | o               | +            |
| 3 51   | Duodenum  | 20 years            | 1 month            | 3 1/2 years        | +                               | o               | +            |
| 1425   | Duodenum  | 4 years             | 1 year             | 3 years            | +                               | o               | +            |
| 661    | Duodenum  | 4 1/2 years         | 10 days            | 1 year             | +                               | +               | o            |
| 1147   | Duodenum  | 2 years             | 2-3 months         | 2 1/2 years        | +                               | o               | +            |
| 1684   | Duodenum  | 10 years            | 8 months           | 2 years            | +                               | o               | +            |
| 183    | Duodenum  | 2 years             | 3-4 months         | 2 years            | +                               | o               | +            |
| 3482   | Duodenum  | 5 years             | 1 year             | 1 year             | +                               | o               | +            |
| 2280   | Duodenum  | 1 year              | 6 months           | 3 years            | +                               | o               | +            |
| 1661   | Duodenum  | 2 years             | 1 month            | 3 years            | +                               | o               | +            |
| 3237   | Duodenum  | 4 years             | 1 month            | 1 1/2 years        | +                               | +               | +            |
| 3256   | Duodenum  | 3 years             | 1 year             | 1 year             | +                               | o               | +            |
| 1142   | Duodenum  | 3 years             | 1 year             | 2 years            | +                               | +               | +            |
| 2526   | Duodenum  | 5 years             | 1 month            | 2 years            | +                               | +               | o            |
| 2437   | Duodenum  | 5 years             | 2 years irreg      | 2 years            | +                               | +               | o            |
| 3772   | Duodenum  | 12 years            | 3 months           | 1 1/2 years        | +                               | o               | +            |
| 3485   | Duodenum  | 1 year              | 9 months           | 1 year             | +                               | o               | +            |
| 3359   | Duodenum  | 5 years             | 6 months           | 1 1/2 years        | +                               | o               | +            |
| 2943   | Duodenum  | 4 years             | 11 months          | 1 year             | +                               | +               | +            |
| 1584   | Duodenum  | 3 years             | 1 year             | 2 years            | +                               | o               | +            |
| 84     | Duodenum  | 3 years             | 9 months           | 2 years            | +                               | o               | +            |
| B1482  | Duodenum  | 3 1/2 years         | 16 months          | 8 months           | +                               | +               | o            |
| 1444   | Duodenum  | 8 years             | 1 1/2 years        | 1 1/2 years        | +                               | +               | o            |
| B1842  | Duodenum  | 10 years            | 1 year             | 6 months           | +                               | +               | o            |
| 3576   | Duodenum  | 7 years             | 2 years irreg      | 1 year             | +                               | o               | +            |
| 3257   | Duodenum  | 3 years             | 1 year             | 1 year             | +                               | +               | +            |
| 98     | Gastric   | 6 months            | 6 months           | 3 years            | +                               | o               | +            |
| 1591   | Gastric   | 13 days             | 3 years            | 2 years            | +                               | +               | +            |
| 2164   | Gastric   | 10 days             | 6 months           | 1 year             | +                               | o               | +            |
| 3748   | Gastric   | 3 years             | 8 months           |                    | +                               | +               | o            |
| B 549  | Secondary | 1 year              | 1 year             | 2 years            | +                               | o               | +            |
| B 37   | Secondary | 4 years             | 1 1/2 years        | 2 years            | +                               | +               | o            |

An analysis of the detailed table in regard to the duration of symptoms and the duration of treatment brings to light several points of interest. Five patients stopped treatment as soon as the month's hospital control was finished. Of these only one has relapsed, an apparent healing of 80 per cent. Patient 11, one of the five who did not continue treatment, has not had a relapse although she had had ulcer symptoms for 20 years. Because of its irksomeness other patients continued treatment for only 2, 3 or 4 months. Of 10 patients who were under treatment for 4 months or less only 2 relapsed, 20 per cent.

Of the 10 patients of the entire series who relapsed 8 were faithful to their treatment for from 6 months to a year and a half. The average time was 13 1/2 months. To be sure unrecognized complications may have been present which made healing impossible from the beginning, but because patients treated by ambulatory methods do not respond well and because several patients in this series were not given alkalis at all and their stomachs were not aspirated after the initial examination, one may well believe that bed rest is a most important factor in ulcer treatment and that the greater part of the

under way. The cases which did not show these evidences of healing were excluded from the group. Patients were kept at bed rest in the hospital most of the time for an entire month. They were treated by the Sippy plan of ulcer management modified in a number of cases because of an intolerance to alkalis or because of some other disturbing factor. Fourth, only patients whose social and economic conditions permitted a careful and long continued course of medical treatment were accepted. They were required to return for re-examination from time to time until the final data were collected in December of last year. Those who refused to return or could not do so were excluded from the group. Thus a small series of carefully selected and carefully controlled cases was collected in the ways indicated and the end results studied. The series contains 35 duodenal, 4 gastric and 2 secondary ulcer cases, a total of 41 cases. The duration of time, since treatment was concluded, varies from 6 months (1 case) to 5 years. The accompanying tables give briefly the important points of the study.

The important conclusion to be drawn from the study is that seemingly a fair percentage of uncomplicated peptic ulcers may be healed by medical methods. It is evident that an ulcer of less than 1 year's duration heals more readily than an older one. Although of the five chronic duodenal ulcers of less than 3 years' duration none has relapsed yet a visible defect remains in each one. This fact raises a doubt as to whether actual healing has occurred for the roentgenologist is not able to distinguish a healed ulcer scar with deformity from a flattened inactive ulcer niche. One is compelled imperfectly to judge the state of healing by the absence of spasm, local tenderness and subjective symptoms. The more acute ulcer has a tendency to heal with a complete disappearance of all deformity. Thus the uninformed roentgenologist has an opportunity to deny the previous existence of an ulcer greatly to the disquietude of a patient who has painstakingly carried out a plan of ulcer management for a series of months.

Question as to the certainty of complete healing is fair. It is raised by the fact that of

## DUODENAL ULCERS

|                     | A |    |   | Ch | Per cent | Corrected |                 |
|---------------------|---|----|---|----|----------|-----------|-----------------|
|                     | N | P  | r |    |          | A         | E to 5 Per cent |
| Number              | 0 |    |   | 26 |          |           |                 |
| Healed              | 8 | 29 |   | 19 | 73       | 16        | 61.5            |
| Defect in healed    | 4 |    |   | 19 |          |           |                 |
| No defect in healed | 4 |    |   | 0  |          |           |                 |
| Not healed          | 1 |    |   | 7  |          | 10        |                 |

## GASTRIC ULCERS

|                     | Acute | Chronic |
|---------------------|-------|---------|
| Number              | 3     | 1       |
| Healed              | 3     | 0       |
| Not healed          | 0     | 1       |
| Defect in healed    | 1     | 0       |
| No defect in healed | 2     | 0       |

## SECONDARY ULCERS

|               |   |
|---------------|---|
| Chronic cases | 2 |
| Healed        | 1 |
| Not healed    | 1 |

## MEDICALLY TREATED CHRONIC DUODENAL ULCER

| Number | Duration  | Healed | Relapsed |
|--------|-----------|--------|----------|
| 1      | 1-2 years | 2      | 0        |
| 3      | 2-3 years | 3      | 0        |
| 0      | 3-4 years | 3      | 1        |
| 4      | 4-5 years | 2      | 2        |
| 4      | 5-6 years | 3      | 1        |
| 1      | 7 years   | 1      | 0        |
| 1      | 8 years   | 0      | 1        |
| 2      | 10 years  | 1      | 2        |
| 1      | 12 years  | 1      | 0        |
| 1      | 20 years  | 2      | 0        |
| 1      | 34 years  | 0      | 1        |

the 19 chronic duodenal ulcers believed to be healed in December 1924, three have relapsed to date (August 1925) since the compiling of the original table. Two of these patients (case 1 and case 24) began to have distress and showed signs of activity of the ulcer roentgenologically after drinking alcoholic beverages. A third patient (case 16) had a sudden severe hemorrhage without warning and roentgenological examination showed evidence of an active ulcer. On the other hand, healing does occur for when patient 18 recently underwent an operation for cholecystitis, Dr. Epplen of Spokane wrote me that the healed scar of a duodenal ulcer was observed.

MORPHOLOGICAL CHANGES ASSOCIATED WITH PARTIAL OCCLUSION OF THE PULMONARY VEINS OF ONE LUNG<sup>1</sup>

By KARL SCHLAEPFER M.D. MILWAUKEE WISCONSIN

THE experiments reported were designed to determine both the immediate and remote clinical and anatomical changes in one lung following partial occlusion of the associated pulmonary veins, with and without section of the phrenic nerve. A chronic stasis is created in the pulmonary circulation similar to that present in many cardiac lesions. Interest in this work has been stimulated by the reports of Tiegel concerning the effect of chronic stasis in the pulmonary circulation on experimental hamatogenous pulmonary tuberculosis.

## METHODS OF EXPERIMENTATION

With intratracheal ether insufflation and anesthesia the following operation was performed on 12 dogs. Through an incision in the fifth left intercostal space the chest cavity was opened and the lung retracted. The region of the hilus was exposed and the pulmonary veins usually three in number were reduced in caliber to one third or one fourth of the original size. The extent of occlusion was regulated by inserting probes of variable sizes through the ligating loop of silk. After partial occlusion of the veins and before the wound was sutured the lung was fully expanded and kept well distended while the chest wall was being closed. In five of the 13 animals the phrenic nerve was resected for a length of 2 centimeters at the point of passage over the pericardium. The difference in the postoperative course in the two groups of animals was negligible.

## EFFECT OF THE OPERATION

In one instance death resulted immediately after the operation, one half hour after the veins were narrowed to one fourth of their previous diameter. At necropsy the right ventricle was greatly distended. The 12 other animals were less active during the recovery from ether anesthesia and respirations were more frequent and shallow. In 5 of these when

the phrenic nerve was cut, the saliva was mixed with blood for the first 2 days. Forty eight hours after operation, all 12 animals had overcome the shock of the operation and were generally as active as before, remaining well until the experiment was terminated. A detail constantly observed at autopsy should be mentioned here. To prevent the collapse of the lungs when the chest was opened at autopsy the trachea was crushed with a clamp and tied with a piece of tape. Although a partial collapse particularly of the lung not operated upon proved unavoidable, the factor of collapse remained constant throughout the series.

## EXPERIMENTAL FINDINGS

The results of the experiments can be most easily disclosed by type protocols for animals dying from 2 to 3 1/4 days after operation and by studies made at the end of the first and second week and continued up to 1 year after partial occlusion of the pulmonary veins of one lung.

*Protocol 1.* Medium sized dog. The left pulmonary veins were occluded to one third of their former diameter and the phrenic nerve sectioned as described above. Increasing dyspnea was the most marked clinical phenomenon until death in 2 days.

*Gross notes.* No deformity of the thorax was noted. When the pleural cavities were opened the right lung which had not been operated upon collapsed somewhat. The left lung with the pulmonary veins partially occluded remained unchanged. No free fluid and no adhesions were found. The pleura was smooth and glistening everywhere. The right side of the heart was moderately dilated. The left lung was bluish red firm throughout and on section yielded hemorrhagic fluid mixed with a few air bubbles. The lung on the side of operation was larger than the pink one opposite which was normally crepitant and moist.

*Microscopic notes.* In the left lung many alveoli were filled with red blood corpuscles which compressed the alveolar walls. Others were greatly congested. The bronchi contained numerous red blood cells and a few leucocytes. In the right lung the alveoli were either empty or contained a homogeneous pink material. The capillaries in the alveolar walls were distended. The bronchi were empty.

From The Brady Laboratory (Pathology and Bacteriology) Yale University School of Medicine, New Haven, Conn. and The Surgical Histology Laboratory, The Johns Hopkins University, Baltimore, Maryland.

healing or possibly all of it occurs during the period of confinement. Possibly it would be more logical to increase the period of bed rest to 2 months and to continue thereafter merely with a bland finely divided diet than to shorten the period to 2 weeks or less and maintain a long program of drugging and aspirating as is now often done.

#### RÉSUMÉ

A series of carefully selected and controlled peptic ulcer cases have been studied from the standpoint of their end results following medical management. Of the acute duodenal ulcers that is ulcers of less than 1 year's duration 89 per cent have been apparently cured after periods of time varying from 1 to 5 years. Sixty one and five tenths per cent of the chronic duodenal ulcers have been apparently cured but a word of doubt is expressed

about the ultimate healing of cases in which there remains definite and permanent deformity. Fifty per cent of the acute ulcers and all of the chronic ulcers apparently heal with this deformity. Acute gastric ulcers apparently heal favorably under medical treatment. It is evident that some secondary ulcers heal in like manner.

The suggestion is made that a long period of bed rest may be one of the most important principles if it is not the most important principle which is involved in medical ulcer therapy.

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MORPHOLOGICAL CHANGES ASSOCIATED WITH PARTIAL OCCLUSION OF THE PULMONARY VEINS OF ONE LUNG<sup>1</sup>

By KARL SCHLAEPFER M D MILWAUKEE WISCONSIN

THE experiments reported were designed to determine both the immediate and remote clinical and anatomical changes in one lung following partial occlusion of the associated pulmonary veins with and without section of the phrenic nerve. A chronic stasis is created in the pulmonary circulation similar to that present in many cardiac lesions. Interest in this work has been stimulated by the reports of Tiegel concerning the effect of chronic stasis in the pulmonary circulation on experimental hæmatogenous pulmonary tuberculosis.

## METHODS OF EXPERIMENTATION

With intratracheal ether insufflation anaesthesia the following operation was performed on 13 dogs. Through an incision in the fifth left intercostal space the chest cavity was opened and the lung retracted. The region of the hilus was exposed and the pulmonary veins usually three in number were reduced in caliber to one third or one fourth of the original size. The extent of occlusion was regulated by inserting probes of variable sizes through the ligating loop of silk. After partial occlusion of the veins and before the wound was sutured the lung was fully expanded and kept well distended while the chest wall was being closed. In five of the 13 animals the phrenic nerve was resected for a length of 2 centimeters at the point of passage over the pericardium. The difference in the postoperative course in the two groups of animals was negligible.

## EFFECT OF THE OPERATION

In one instance death resulted immediately after the operation one half hour after the veins were narrowed to one fourth of their previous diameter. At necropsy the right ventricle was greatly distended. The 12 other animals were less active during the recovery from ether anaesthesia and respirations were more frequent and shallow. In 5 of these when

the phrenic nerve was cut, the saliva was mixed with blood for the first 2 days. Forty eight hours after operation all 12 animals had overcome the shock of the operation and were generally as active as before, remaining well until the experiment was terminated. A detail constantly observed at autopsy should be mentioned here. To prevent the collapse of the lungs when the chest was opened at autopsy the trachea was crushed with a clamp and tied with a piece of tape. Although a partial collapse particularly of the lung not operated upon proved unavoidable, the factor of collapse remained constant throughout the series.

## EXPERIMENTAL FINDINGS

The results of the experiments can be most easily disclosed by type protocols for animals dying from 2 to 3½ days after operation and by studies made at the end of the first and second week and continued up to 1 year after partial occlusion of the pulmonary veins of one lung.

*Protocol 1.* Medium sized dog. The left pulmonary veins were occluded to one third of their former diameter and the phrenic nerve sectioned as described above. Increasing dyspnoea was the most marked clinical phenomenon until death in 2 days.

*Gross notes.* No deformity of the thorax was noted. When the pleural cavities were opened the right lung which had not been operated upon collapsed somewhat. The left lung with the pulmonary veins partially occluded remained unchanged. No free fluid and no adhesions were found. The pleura was smooth and glistening everywhere. The right side of the heart was moderately dilated. The left lung was bluish red firm throughout and on section yielded hemorrhagic fluid mixed with a few air bubbles. The lung on the side of operation was larger than the pink one opposite which was normally crepitant and moist.

*Microscopic notes.* In the left lung many alveoli were filled with red blood corpuscles which compressed the alveolar walls others were greatly congested. The bronchi contained numerous red blood cells and a few leucocytes. In the right lung the alveoli were either empty or contained a homogeneous pink material. The capillaries in the alveolar walls were distended the bronchi were empty.

From the Brady Laboratory of Pathology and Bacteriology, Yale University School of Medicine, New Haven, Connecticut. <sup>1</sup> The Surgical Research Laboratory, Johns Hopkins University, Baltimore, Maryland.

Briefly the lung in which the pulmonary veins were partially occluded was large and firm as a result of the great congestion and extensive hemorrhages into the alveoli as confirmed by microscopic examination. The opposite lung showed great congestion.

In another dog on which the same operation had been performed and which died with similar symptoms after 3½ days the findings at autopsy were in general the same except for circumscribed fibrinous adhesions to the wound in the chest wall and to the mediastinum.

**Protocol 2** Medium sized dog. The left pulmonary veins were narrowed to one fourth of their original caliber. Recovery was uneventful. After 24 hours the animal was as active as before operation and it remained well until the experiment was terminated 1 week later.

**Gross notes.** No deformity of the chest was noted. The diaphragm stood at its usual level on both sides. The left lung was adherent to the chest wall by fibrinous adhesions which partly obliterated the pleural cavity. There was a moderate herniation toward the side of operation of the upper and lower part of the anterior mediastinum where it is thinnest. The right lung collapsed somewhat. The lung with the narrowed veins remained distended and both lungs were of the same size (Fig. 1). The right heart was not markedly dilated. The left lung was bluish red and firm and on section yielded only a few air bubbles. The right lung was normally crepitant and moist.

**Microscopic notes.** In the left lung most alveoli contained desquamated alveolar lining cells and some leucocytes mixed with red blood corpuscles. Phagocytosis was frequently encountered. The alveolar walls contained dilated capillaries (Fig. 2). The bronchi were either empty or contained cellular debris and some leucocytes. In the right lung the alveoli were empty or contained pink material. The alveolar walls contained dilated capillaries (Fig. 3). The bronchi were empty.

To recapitulate at the end of the first week there were extensive pleural adhesions of the lung with the pulmonary veins partially occluded. The opposite lung not operated upon pushed the anterior mediastinum in its thinnest places to the side of operation but at autopsy this control lung collapsed somewhat so that both lungs were the same size. The lung with the veins narrowed to one fourth was firm and showed microscopically hemorrhages mixed with an inflammatory exudate filling the alveoli. Phagocytosis within the alveoli was quite conspicuous.

**Protocol 3** Large dog. The left pulmonary veins were reduced to one fourth of their original caliber. Recovery was uneventful and complete after 24 hours. The experiment was terminated after 2 weeks.

**Gross notes.** No chest deformity was noticed. The lung with the pulmonary veins partially occluded was adherent to the chest wall along the scar of operation and to the mediastinum. Dilated blood vessels passed from the lung surface through these adhesions

to the intercostal veins and into the mediastinum where they joined the internal mammary vein. The herniations in the anterior mediastinum extended to the side of operation for a distance of 3 centimeters. The lungs corresponded in appearance to the description in Protocol 2.

**Microscopic notes.** In the left lung in which the veins were partially occluded the alveoli were empty and the capillaries in the alveolar walls dilated and tortuous with a slight increase of the perivascular tissue. The medium sized blood vessels showed a thickening of the wall as compared with analogous blood vessels of the opposite control lung. In the right lung the alveoli were distended and the capillaries in the alveolar walls dilated.

**Summary.** At the end of 2 weeks pleural adhesions were found at the site of the chest incision in the lung with the pulmonary veins partially occluded. These adhesions led to the formation of venous collaterals from the surface of the lung into tributaries of the superior vena cava.

The herniation of the mediastinum resulting from the expansion of the lung not operated upon was conspicuous. The firmness of the lung in which the veins were reduced to one fourth of the original caliber was increased due to a general congestion. In some areas an incipient fibrosis was visible in the perivascular tissue of the capillaries and a medium sized blood vessels.

**Protocol 4** Large dog. The left pulmonary veins were occluded to one fourth of the original caliber. Uneventful recovery followed and the animal remained well until the experiment was terminated 1 month after the operation.

**Gross notes.** No deformity of the chest was found. The lung with veins reduced to one fourth normal caliber showed adhesions along the scar of operation on the anterior chest wall with venous collaterals passing through them. The bronchial veins were greatly enlarged on this side and the number of branches was increased. The displacement of the anterior mediastinum already mentioned in previous protocols remained the same. The lung with the veins partially occluded was dark blue and firm and one fifth smaller than the opposite control lung which was crepitant and moist.

**Microscopic notes.** In the left lung areas of empty alveoli with thin walls and congested blood vessels alternated with areas in which the empty alveoli were outlined by thickened walls due to a connective tissue increase around the blood vessels (Fig. 4). The bronchi were empty. The right lung the untouched lung showed uniformly dilated capillaries in the alveolar walls with absence of any connective tissue growth (Fig. 5).

In this case of 1 month's duration the herniation in the anterior mediastinum seemed to have become stabilized. Pleural adhesions to the scar of operation gave rise to venous collaterals. The bronchial veins also were greatly distended and emerged with numerous enlarged branches from the hilus of the lung the pulmonary veins of which were partially oc-

cluded. This lung was somewhat smaller and firmer than the opposite lung. The fibrous tissue along the walls of the dilated capillaries in the alveolar septa was particularly conspicuous in the vicinity of the bronchi and larger blood vessels. The process was irregularly distributed throughout the section. The alveoli were empty. On cross section the thickening of the medium sized blood vessels was evident. The changes in the lung with the veins partially occluded were practically the same after 2 months as after 1 month. The opposite control lung pushed the mediastinum at its thinnest places to the side operated on. The mediastinal lobe of the right lung expanded below the heart toward the lower portion of the lung with the occluded pulmonary veins (Figs. 6 and 7). Adhesions along the mediastinum were found. The lung in which the veins were reduced in caliber was smaller and firm in consistency. On section it yielded blood stained fluid and a few air bubbles. The opposite control lung was crepitant and moist. Microscopically the connective tissue increase within the alveolar walls in the lung with the pulmonary veins reduced to one fourth was quite conspicuous but irregularly distributed throughout the field (Fig. 8). The changes were most advanced in the vicinity of the bronchi and larger blood vessel. Dilatation of all the blood vessels in the right lung was the only finding of note.

**Protocol 5.** Medium sized dog. The left pulmonary veins were reduced to one third and the phrenic nerve sectioned. Recovery was uneventful and the animal remained well. The experiment was terminated at the end of 3 months.

**Gross notes.** No deformity of the thorax or spine was noted. The paralyzed diaphragm was one intercostal space higher than the intact one. The displacement of the mediastinum was the same as that mentioned previously. Pleural adhesions to the scar of operation and to the mediastinum were

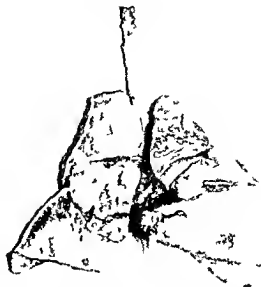


Fig. 1. Lungs 7 days after partial occlusion of the left pulmonary veins.

found. The bronchial veins emerged with enlarged tortuous branches from the hilus of the lung with the pulmonary veins partially occluded. Their caliber was three times as large as that of the bronchial veins of the lung not operated upon. The lung with the pulmonary veins partially occluded was firm and somewhat smaller and yielded on section only a few air bubbles whereas the opposite lung was normally crepitant and moist.

**Microscopic notes.** In the left lung the alveoli were empty but narrowed by the thickened alveolar walls due to distention of the capillaries and the

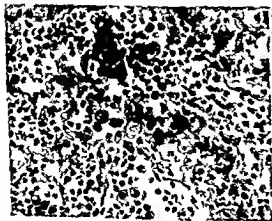


Fig. 2. Photomicrograph of lung 7 days after partial occlusion of pulmonary veins. Red blood cells desquamated alveolar lining cells and leukocytes fill alveoli. The blood vessels in the alveolar walls are congested (375 X).

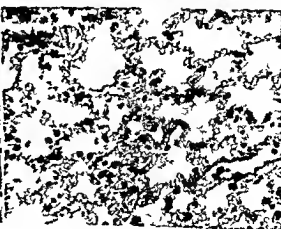


Fig. 3. Photomicrograph of the opposite lung which has not been subjected to operation. Empty alveoli and dilated capillaries in the alveolar wall are noted in this section (375 X).





Fig. 4. Photomicrograph of the lung 1 month after partial occlusion of the pulmonary veins. There is some increase in connective tissue in the alveolar walls (375 X)



Fig. 5. Photomicrograph of the lung 1 month after partial occlusion of the pulmonary veins of the opposite lung (375 X)

connective tissue growth around the blood vessels. The process was not uniform throughout the sections. In the right lung empty alveoli and alveolar

walls with dilated capillaries were the only findings of note.

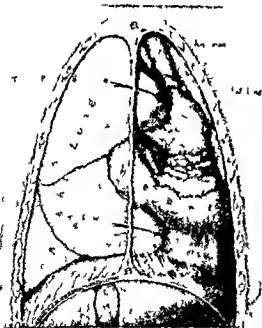


Fig. 6. Anterior view of the chest 85 days after partial occlusion of the left pulmonary veins. The expanding lung not operated upon pushes the mediastinum toward the lung whose pulmonary veins are partially occluded thus forming herniations in the mediastinum where it is thinnest (upper and lower grooves). New venous collaterals arising from the surface of the lung with partially occluded pulmonary veins empty into the internal mammary vein.

After 3 months the gross findings were almost the same as those observed after 2 months with slight variations in the four specimens from experiments of almost the same duration (85, 85, 90, 95 days). Pleural adhesions of the lung with the pulmonary veins partially occluded were found at the usual location, namely, the scar of operation and the mediastinum near the hilus. In two instances dilated branches of the internal mammary vein with radicles arising from the surface of the lung in which pulmonary veins were narrowed passed through the anterior mediastinum by way of mediastinal adhesion. In three observations the bronchial veins were greatly dilated as they emerged from the hilus. Branches communicating with the esophageal veins and with the pericardiophrenic veins were also dilated (Fig. 9). In comparing the caliber of the two pulmonary arteries the right side was noticeably larger. The lung in which the veins were reduced in caliber was firm and somewhat smaller.

Microscopically, the process of fibrosis had progressed very slowly. Variations in specimens from experiments of the same duration were noticed. Dilatation of all the capillaries with absence of any connective tissue proliferation within the alveolar walls was a constant finding in the lung which had not been subjected to operation.

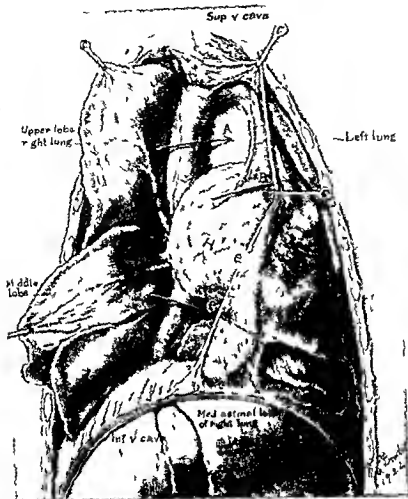


Fig 7 Same as Figure 6 The right mediastinal lobe expands posteriorly to the inferior vena cava toward the left lateral chest wall

In a specimen from an experiment of 4 months duration the gross changes were essentially the same. No deformity of the thorax was noted. The pleural adhesions were restricted to the usual places. The displacement of the thinnest portions of the mediastinum to the side of operation was distinct. The bronchial veins on the side with partial occlusion of the pulmonary veins were 3 times the caliber of those on the opposite side. The pulmonary artery on the side of operation was larger than on the opposite side. The lung in which the veins were reduced in size was smaller and felt firm.

Microscopically the connective tissue proliferation within the alveolar walls was conspicuous. It also involved the sheath of the medium sized blood vessels. On gross and microscopic examination the lung not operated upon always showed the same picture as that mentioned.

**Protocol 6** Medium sized dog. The left pulmonary veins were occluded to one fourth of their original size. For 3 days the respiration was accelerated and deep. The animal remained well. The experiment was terminated after 1 year.

**Gross notes.** No deformity of the thorax or spine was noted. There was a marked displacement of the mediastinum in its thinnest portions to the side



Fig 8 Photomicrograph of the lung with reduced pulmonary veins 2 months after operation. The increase of connective tissue in the alveolar walls is quite conspicuous (375 X)

of operation. Below the heart the enlarged mediastinal lobe of the right lung pushed the mediastinum toward the side of operation. The lung with constricted veins showed fibrous adhesions to the mediastinum to the adjacent portion of the diaphragm and around the scar of operation. New collateral veins were noted arising from the lung surface and going through these pleural adhesions into intercostal veins. The left mammary vein was much larger than the right. Other newly formed veins passed from the medial surface of the lung through the mediastinum into the superior vena cava. Branches taking their origin from the lower lobe of the lung entered the diaphragm. Along the phrenic nerve enlarged vessels reached the first intercostal vein. On the side of operation the bronchial veins were greatly distended in their whole course and in their communications with the esophageal veins and the pericardiophrenic veins. The right pulmonary artery was larger than the left. A hypertrophy of the wall of the right ventricle was noted and confirmed microscopically by the greater size of the muscle fibers as compared with those in the left side. The lung with the pulmonary veins reduced in caliber was one fifth smaller than the opposite lung (Fig 10) and felt firm when compared with the crepitant right lung. On section only a few air bubbles were obtained from the lung with the constricted veins. The opposite lung was moist.

**Microscopic notes.** In the left lung the alveoli were empty. A connective tissue proliferation was associated with irregular thickening of the alveolar walls and was more advanced in areas situated near the larger blood vessels and the vicinity of bronchi (Fig 11). On cross section the walls of the blood vessels showed a definite thickening visible even in the main branches of the pulmonary artery. Through out the section of the right lung the alveoli were large and empty and the capillaries in the alveolar walls were distended (Fig 12).

Summing up at the end of 1 year there was no thoracic deformity but there was displacement of the mediastinum at anatomically weak places. The pleural adhesions on the anterior and medial side gave rise to the formation of venous collaterals draining into the superior vena cava. Also the bronchial veins were greatly distended in their whole course and their branches communicated with the esophageal and the pericardiophrenic veins. The main pulmonary artery of the lung with the constricted veins was decidedly smaller than the corresponding vessel of the opposite lung. A hypertrophy of the right ventricle was demonstrable. The lung with the veins partly occluded was one fifth smaller than the opposite side was firm and on section yielded few air bubbles.

Microscopically the left lung with the veins reduced in caliber showed empty alveoli narrowed by irregularly thickened alveolar walls due to connective tissue growth particularly around the small and medium sized blood vessels but even demonstrated in the large vessel. In the lung not operated upon the alveoli were empty, the alveolar walls were thin and contained dilated capillaries.

#### COMMENT

In the dog, great congestion with hemorrhages into the alveoli was the immediate effect after partial occlusion of the pulmonary veins of one lung. Grossly the organ became large and firm. The opposite lung which was not subjected to operation became distended and pushed the mediastinum at its anatomically weakest places to the side of operation. The herniation was not very conspicuous in the upper mediastinum where a moderate bulge found during the first month and later was the maximum change. Below the heart where the mediastinal lobe of the right lung expanded toward the side of operation the hernia was easily visible. After 1 month the process was fairly well stabilized.

Pleural adhesions on the side of ligation were restricted to the places of trauma during operation to the wound in the anterior chest wall and to the mediastinum near the hilus. The amount of adhesion varied in different observations. In one instance they were quite extensive. Where the pleura was free it remained thin and glistening. These pleural adhesions formed the path for new venous collaterals arising from the surface of the lung with the constricted veins and running into different tributaries of the superior vena

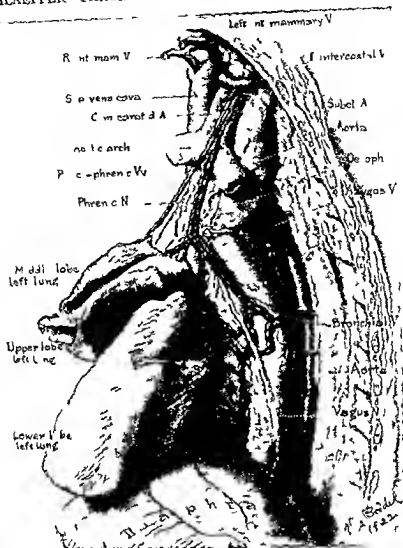


Fig. 9 From the hilus of the lung with the pulmonary veins partially occluded the bronchial veins emerge as large tortuous vessels

cava. This method of overcoming the congestion resulting from the partial occlusion of the pulmonary veins was present in 5 experiments (15, 85, 95, 130, 355 days). Where these pleural adhesions were not considerable and the collaterals just described therefore were not well established another mode of venous outlet occurred. The bronchial veins and their communications with the esophageal veins and with the pericardio-phrenic vein became greatly enlarged. This was present in six instances (30, 85, 90, 95,

130, 355 days). In two instances (85 and 355 days) both forms of collaterals were demonstrated at necropsy. In a previous publication the clinical importance of this repair process in a greatly congested lung was discussed fully.

Size comparison of the two lungs at necropsy was not entirely satisfactory inasmuch as at necropsy the crepitant lung which had not been operated upon collapsed somewhat whereas the lung with the veins reduced in caliber was firm and remained unchanged in



Fig. 10. Lungs 1 year after partial occlusion of the left pulmonary veins

size Preliminary tight closure of the trachea before opening the chest proved ineffective in preventing partial collapse of the lung not operated upon. In experiments of a few days duration the lung with the constricted veins was somewhat larger than the opposite lung. Specimens from experiments of 2 weeks duration showed the size of the two lungs to be about equal after 1 and 2 months and up to 1 year the lung with the occluded veins had become somewhat smaller and its consistency markedly denser.

From the end of the third month and always thereafter the caliber of the pulmonary artery of the side not operated upon was larger than the artery of the side of operation. Associated hypertrophy of the wall of the right ventricle became more and more conspicuous as demonstrated on microscopic examination of a specimen from an experiment of 1 year's duration. Dilatation of the right ventricle was not very marked even after 1 year.

On section the lung with the constricted veins yielded hemorrhagic fluid. Frothy fluid was obtained from the opposite lung in all specimens.

Microscopically the lung with the pulmonary veins partially occluded showed great

congestion and areas of hemorrhages in the first week. The hemorrhages were more extensive when the phrenic nerve had been cut. At the end of the first week desquamated alveolar lining cells and leucocytes were mixed with red blood cells. The blood vessels were greatly dilated throughout the section. Later the alveoli gradually emptied and by the third week some contained a few phagocytic cells only. A proliferation of connective tissue along the capillaries within the alveolar walls was conspicuous and increased very slowly in the following weeks and months. On cross section the medium sized blood vessels showed a definite thickening of the wall which was gradually augmented in the course of months and developed parallel with analogous changes around the capillaries. This process of fibrosis was irregularly distributed throughout the organ. After 2 or 3 months small strands of connective tissue connected bronchi and larger blood vessels and surrounded zones where the proliferation was less advanced. After a year the fibrosis of the lung with the reduced veins was well marked in the perivascular tissue around the capillaries in the alveolar wall and around the medium sized branches of the pulmonary artery.

The opposite lung showed microscopically the same picture throughout the whole series empty large alveoli and dilated capillaries in the alveolar walls without any evidence of connective tissue proliferation.

The congestion in the lung with the obstructed vessels is combated in two ways. Venous collaterals with veins of the chest wall (intercostal) and veins of the chest wall (intercostal) are formed through pleural adhesions or pre-existing veins such as the bronchial dilate. This dilatation also involves the vessels communicating with the esophageal veins and with the pericardio-phrenic vein.

In the lung not operated upon dilatation of all the blood vessels occurs. This general dilatation diminishes the peripheral resistance and facilitates the blood flow through the lung. It gradually causes a retrograde dilatation of the small blood vessel and finally of the main branch of the pulmonary artery in the lung not operated upon as demonstrated



Fig. 11 Photomicrograph of the lung, the pulmonary veins of which were reduced to one fourth the original size 1 year previously. Note the marked increase in fibrous tissue in the alveolar wall and around the medium sized blood vessels (35 X).



Fig. 12 Photomicrograph of the lung not operated upon 1 year after partial occlusion of the pulmonary veins of the opposite lung. There is no increase in connective tissue visible (375 X).

in the specimen taken from a dog in which the experiment was of 1 year's duration.

General dilatation of all the capillaries in the alveolar walls of the lung not operated upon may be one factor which causes dilatation of this lung. Von Basch illustrated this mechanism by forcing water through a rubber tube fixed in a slightly oblique coil about a rubber bag; the force of the fluid in the tube determines the extent of expansion of the bag.

Clinical observations concerning diminished susceptibility to tuberculosis of persons with left-sided heart lesion may be explained on the basis of pulmonary congestion with subsequent fibrosis as noted by Rokitsansky, Fraentzel and Eichhorst (Johanne) and demonstrated in the experiments reported in this communication. In 1911 Tiegel confirmed this assumption by experiments. With silver wire he partially occluded the pulmonary veins of one lung in rabbits and dogs. One month later he injected a suspension of tubercle bacilli intravenously and sacrificed the animals after 2 to 3 months. The lung with partially occluded pulmonary veins was decidedly less affected; the tuberculous lesions were small, well defined with no tendency to caseation but with distinct evidence of proliferation and healing by fibrosis. The nearer the occlusion reached total obstruction the less frequent and smaller were the tuberculous lesions encountered in this lung.

#### SUMMARY

Partial occlusion of the pulmonary veins of one lung immediately causes a great stasis in this lung and hemorrhages into the alveoli. Hemorrhages are more extensive when the phrenic nerve is sectioned.

Dogs may die during or shortly after the reduction of the size of the pulmonary veins or from 1 to 2 days after the operation with increasing dyspnea, congestion, hemorrhages into the lung with the obstructed veins and dilatation of the right ventricle. If the animals survive the acute effect of the operation, complete recovery occurs within 48 hours and they remain quite well throughout the experimental periods.

Displacement of the mediastinum toward the side of operation at its thinnest places results from a dilatation of the lung not operated upon. The lung with the veins reduced in size is compressed. When the chest is opened at necropsy, an inevitable partial collapse of the lung not operated on makes it impossible satisfactorily to demonstrate this change after death.

Pleural adhesions are noted at the places of greatest trauma during the operation in the line of incision on the anterior chest wall and in the mediastinum near the hilus.

These pleural adhesions form the pathway for the establishment of new venous outlets from the congested lung into tributaries of the

superior vena cava. Another way of diminishing this congestion is the dilatation of pre-existing vessels such as the bronchial veins and their communication with other veins. The clinical importance of these collaterals has been discussed fully in a previous publication.

In the lung not operated upon the dilatation of the blood vessels noted in the alveolar capillaries immediately after the partial occlusion of the pulmonary veins of the opposite lung gradually distends the medium sized and larger blood vessels. After 1 year the circumference of the pulmonary artery of the side not subjected to operation is larger than that of the other side.

Microscopically in the lung with the pulmonary veins partially occluded the hamorrhages in the alveoli disappear but the congestion remains. A proliferation along the capillaries in the alveolar walls is noted in the third week. It increases very slowly and ultimately causes a thickening of the alveolar

walls. Around the larger blood vessels also a connective tissue growth is noted. The resulting fibrosis is irregularly distributed throughout the lung.

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### ACTINOMYCOSIS BOVIS OF THE LEG

By C. MILTON LINTHICUM, M.D., F.A.C.S., BALTIMORE

THE assumed belief among the profession that actinomycosis is a rare disease leads me to report a case. I say assumed because a thorough investigation of the subject has shown a number of unreported cases. The difficulty in making a diagnosis in my case prompts me to believe that many discharging actinomycotic sinuses and ulcerations are unrecognized. I do not wish to suggest that actinomycosis is of frequent occurrence but I do believe that there is a sufficient number to warrant in questionable cases, very careful investigation by repeated microscopical examination of sections taken from several locations in the diseased area and by repeated search for the granules in the pus.

The last complete compilation of cases was made by Sanford of the Mayo Clinic in 1923. This report included 678 cases and followed a report of only 119 cases which was made by Sanford and Magath 7 years previously. The

great increase in number in the second report was due to two things: a more thorough investigation and search for cases and the inclusion of all cases due to a fungus which were formerly classified as nocardia, streptothrix or pseudo-tuberculosis, etc. Sanford was warranted in including such cases as he used the nomenclature of the American Society of Bacteriologists. Before this the classification of J. Homer Wright had been the recognized one. Wright's classification limited the term actinomycosis to infections caused by the actinomycetes bovis which form sulphur granules with club-shaped rays which is not acid fast, is very difficult to grow in culture and ordinarily anaerobic and which disseminate diametrically in the three l.t. characteristics. There is no unanimity in the nomenclature of these fungi and doubtless in time the limitation of Wright will be re-established.



Fig. 1. Photographs of patient's leg showing lesions

Sanford conducted a most intensive search to discover cases. He found 709 cases in the United States definitely reported in the literature. Through health officers he located 87 unpublished cases through letters sent to hospitals and medical schools. 148 cases were added letters published in the *Journal of the American Medical Association* and the various state medical and dental publications brought 99 cases to him. 135 cases were reported at Mayo Clinic—a grand total of 469 unpublished cases were found. Since the publication of Sanford's report in 1923, 6 cases have been published and with the one I am citing the total number of known cases in the United States is 685.

It is an interesting fact that actinomycosis in cattle was long considered a form of sarcoma of the jaw. Bollinger however in 1877 definitely proved that it was a vegetable parasitic infection caused by a micro organism to which Hartz gave the name of *actinomyces bovis* because of the radiate colonies of vegetable growths found in the tissues. Shortly after this J. Israel reported a case in man. He described the organism but did not recognize the fact that the micro organism he found was identical with that described by Bollinger. The identification of the bovine and human infections was first made by Ponfik in 1879. The first case in the American literature was reported by John B. Murphy in 1885.

Sanford's conclusion as to the geographical distribution is that the disease is widespread but he intimated that its apparent frequency

in the Atlantic Coast States was due probably to the particular attention which had been given to the search for cases.

The usual impression is that the disease is the result of direct animal contact, but we find that about one half of the reported cases did not come in contact with animals at all.

Cases were in either an acute or chronic stage. The infection occurred usually in early life although patients in later life have suffered from the disease. One patient was 28 days old and two were men aged 82 years.

The most common sites of infection in order of frequency are the head and neck, the abdomen and thorax but rarely the limbs.

The infecting agent as described by Wright is a small pale yellowish irregular granule varying in size from a fraction of a millimeter to 1 to 2 millimeters—the so called 'sulphur bodies'. The larger sized body is usually an aggregation of granules which gives it a mulberry like contour. The essential element of the granule is a branching filamentous micro organism which is seen in varying degrees of degeneration and transformation. Over and around the granule is the radiate formation of hyaline club-shaped bodies of different size and thickness but with the definite radial arrangement which is the characteristic feature for diagnosis. How perfect this arrangement is depends upon the development or stage of degeneration.

The manner of infection is still a debated question but careful investigation is being carried on to determine this factor. The gen-



superior vena cava. Another way of diminishing this congestion is the dilatation of pre-existing vessels such as the bronchial veins and their communication with other veins. The clinical importance of these collaterals has been discussed fully in a previous publication.

In the lung not operated upon, the dilatation of the blood vessels, noted in the alveolar capillaries immediately after the partial occlusion of the pulmonary veins of the opposite lung gradually distends the medium sized and larger blood vessels. After 1 year the circumference of the pulmonary artery of the side not subjected to operation is larger than that of the other side.

Microscopically, in the lung with the pulmonary veins partially occluded the hemorrhages in the alveoli disappear but the congestion remains. A proliferation along the capillaries in the alveolar walls is noted in the third week. It increases very slowly and ultimately causes a thickening of the alveolar

walls. Around the larger blood vessels also a connective tissue growth is noted. The resulting fibrosis is irregularly distributed throughout the lung.

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## ACTINOMYCOSIS BOVIS OF THE LEG

By G. MILTON LINTHICUM, M.D., F.A.C.S., BALTIMORE

THE assumed belief among the profession that actinomycosis is a rare disease leads me to report a case. I say assumed because a thorough investigation of the subject has shown a number of unreported cases. The difficulty in making a diagnosis in my case prompts me to believe that many discharging actinomycotic sinuses and ulcers are unrecognized. I do not wish to suggest that actinomycosis is of frequent occurrence, but I do believe that there is a sufficient number to warrant, in questionable cases, very careful investigation by repeated microscopical examination of sections taken from several locations in the diseased area and by repeated search for the granules in the pus.

The last complete compilation of cases was made by Sanford of the Mayo Clinic in 1923. This report included 678 cases and followed a report of only 119 cases which was made by Sanford and Magath 7 years previously. The

great increase in number in the second report was due to two things: a more thorough investigation and search for cases and the inclusion of all cases due to a fungus, cases which were formerly classified as nocardia, streptothrix or pseudo-tuberculosis, etc. Sanford was warranted in including such cases as he used the nomenclature of the American Society of Bacteriologists. Before this the classification of J. Homer Wright had been the recognized one. Wright's classification limited the term actinomycosis to infections caused by the actinomycetobovis which forms sulphur granules with club-shaped rays which is not acid fast, is very difficult to grow in culture and ordinarily anaerobic and which differs diametrically in the three last characteristics. There is no unanimity in the nomenclature of these fungi and doubtless in time the limitation of Wright will be re-established.

growth was very vascular and bled freely on manipulation. It was insensitive ( $\frac{1}{4}$  inch) to touch manipulation or incision. Several sections were removed without pain for examination. The general appearance of the growth was strongly suggestive of an epithelioma or a sarcoma but could be differentiated from epithelioma because of its spongiform architecture, absence of extensive deep destruction and lack of inguinal gland involvement and from sarcoma because the ulceration was well defined.

The diagnosis lay between malignancy, syphilis and one of the streptothrix or fungus lesions. As the first sections sent to the laboratories of the Maryland General Hospital and University of Maryland College of Physicians and Surgeons did not show granules or mycelia, a negative diagnosis was made. They reported that the growth was not sarcoma, epithelioma or syphilis but that it was some unusual tumor. Dr. Bloodgood also examined a section and his report was negative. He found some areas suggestive of xanthoma and some cells of the sarcoma type but melanin was absent. A second specimen was sent to Dr. Bloodgood on which he reported. Sections show skin and an ulcerated area. In the subepidermal tissue there is a diffuse infiltration of polymorphonuclear cells, plasma cells and all sorts of wandering cells. In places there are accumulations of polymorphonuclear cells forming pus.

It was in this pus that we found the sulphur granules of actinomycosis. Slides made by Dr. Bloodgood were examined and the diagnosis confirmed by Dr. Spence of the University of Maryland and by Dr. White of the Maryland General Hospital.

On the early assumption that I was dealing with a case of actinomycosis I first treated the patient with large doses of potassium iodide. As I noted

no improvement I determined to amputate his leg which I did May 1, 1925. He recovered well from his operation and left the hospital July 10, 1925. October 1, 1925 his condition was reported to me by a representative of an artificial limb company who had visited him to outfit him with a leg. He is well and managing his farm.

### CONCLUSIONS

Actinomycosis bovis is not a disease of frequent occurrence nor is it so rare as not to be considered as a strong possibility in chronic suppurating conditions.

The site of the lesion is unusual. This fact taken in conjunction with its onset, tends to confirm the source of infection as *ex corpore*, that is the habitat of the organism is not within the body but is on some form of vegetation which has come in contact with the body.

In our case the fact that the man did not come in contact with infected cattle would suggest that direct animal infection did not occur.

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eral and common belief that it is due to direct infection from animals is not apparently borne out by investigation. This was especially true in the group of 107 cases of head and neck infections reported by Tigi and New in 1923. As yet it has not been definitely determined whether or not the actinomycetes is a normal inhabitant of the mouth and intestine and that the infection occurs through an injury of the mucosa and again whether the organism is not present on hay, wheat, barley or other vegetations and that infection occurs as a result of injury and direct inoculation from this source such as from swallowing a barley head or from chewing wheat or timothy straw or from picking the teeth with them. The case I report would seem to be due to direct infection in an injury from contact with vegetation.

The diagnosis of the disease is based upon the clinical history, especially its chronicity and the confirmation of the diagnosis is dependent upon the finding of the sulphur granules and ray fungus.

CASE NO 1643 April 1, 1925. Patient was a white man married, age 63 years, a farmer. The family history is negative except that one sister died of cancer of the neck. Patient has had the usual diseases of childhood with malaria at age of 16. Nine years ago the skin over the shin bone was denuded by a wagon wheel. This lesion healed in about 1 month. It recurred 4 years later and was cured by a salve in about a month or two. One year ago a sore returned in the seat of the old one since which time it has not yielded to treatment but has rapidly increased in size and depth. Patient continued to work until about 6 weeks ago when he had to give up because the leg became heavy and swollen. He has no pain and feels generally well. No history of contact with lumpy jaw animal could be obtained.

Physical examination shows a poorly nourished, almost emaciated man not acutely ill with no pain. His only complaint is the swollen foot and ankle with a suppurating growth in the lower third of the left leg. The head and neck were negative on examination. The left pupil is irregular with opacity in the upper third of the cornea due to an early injury. The tongue is dry, dirty and furred. The upper teeth are missing with the exception of a few remaining decayed roots. A few carious snags are present in the lower jaw. Marked pyorrhea is present. The thyroid is normal in size. The cervical glands are palpable but not exaggerated. The chest is normal on percussion and auscultation. The heart shows no hypertrophy and heart sounds are distant.

feeble and distinct with extra systole and no murmur. The pulse is of small volume, weak, irregular and intermittent. There is a moderate sclerosis of the peripheral vessels. Blood pressure is 100-70. The abdomen and genito-urinary system is negative. The epitrochlear, inguinal and femoral glands are all palpable with no difference in size of the right and left inguinal. A general chronic adenitis is present.

Examination of the blood showed Wassermann negative, urea 31.4 milligrams per 100 cubic centimeters, leucocytes 13,100, small lymphocytes 20 per cent, large mononuclears 2 per cent, polymorphonuclears 69 per cent.

X-ray examination of the left leg showed thickened periosteum along the lower third of both tibia and fibula. There were denser shadows in the soft tissues which may have been due to some metallic substance in the dressings. X-ray examination of the chest and abdomen showed calcified masses at the roots of both lungs with no evidence of gross pathology in the lung fields to indicate a recent infection from tuberculosis or actinomycosis. Examination of the abdominal cavity was negative. There were marked arthritic deposits on the bodies of the lumbar vertebrae.

Temperature on admission to the hospital was 101.4 degrees and he ran a septic temperature until the leg was amputated when it became practically normal.

Smears made from the pus from the ulcer showed many pus cells, numerous cocci, no actinomycetes or granules. Anaerobic cultures showed no actinomycetes. Guinea pigs injected with pus from the ulcer died at the end of 3 weeks. Sections of the inguinal and lymph gland showed no actinomycetes.

On admission to the hospital patient showed considerable disturbance in mentality. His answers to queries were slow and rather indeterminate and it was only by marked persistence that my assistant Dr. Carter obtained a history which was supplemented and confirmed by relatives. On the tenth day he had delusions of being attacked by a negro with a knife. Feces and urine were voided involuntarily. He had no conception of time and talked irrationally. He was unclean in his habits and had no desire for food and had to be fed. This condition continued until the leg was amputated. No improvement was noted until a few days before he left the hospital when he showed signs of improvement with orientation returning and he expressed a desire to go home.

The left foot and leg to within 3 inches of the knee were markedly edematous, boggy and brawny. On the anterior surface of the lower third of the leg was a large 5 inch fungoid, multilobular growth extending around two thirds of the circumference of the leg. The edges of the sinus were elevated above and overlapped the uninvolved skin. Circumferentially the growth was papillary, multiform and lobulated in character, centrally the area was ulcerated and discharged a dirty pus. The

# CLINICAL SURGERY

FROM THE SURGICAL CLINIC OF THE LONDON HOSPITAL

## OPERATION FOR GASTRIC ULCERS OF THE LESSER CURVE

By A J WALTON, MS, FRCS, BSc, LONDON, ENGLAND

**W**HENEVER possible the operation selected for gastric ulcers of the lesser curve is a wide excision followed by temporary occlusion of the pylorus and a posterior gastro-enterostomy. If however there is narrowing at the site of the ulcer leading to advanced constriction of the hourglass type or if the symptoms show the slightest suggestion of the onset of carcinoma the operation preferred is a partial gastrectomy by the modified Polya method. In very large ulcers which are situated high up and which are firmly adherent to the pancreas a simple gastro-enterostomy is performed as a temporary measure and a year or so later a second operation is performed. By this time the ulcer may have so decreased in size that excision is relatively easy.

### DANGERS AND POSSIBLE COMPLICATIONS TO BE FEARED

With careful investigation by modern methods, including the test meal and X ray, there are few if any complications which should not be realized beforehand and provided against. A gastric ulcer on the lesser curve is frequently associated with a second ulcer at the pylorus or duodenum and not infrequently with gall stones or chronic appendicitis. The conditions which may give rise to the greatest difficulty at operation are the presence of firm adhesions to the pancreas and the onset of carcinoma. A careful investigation of the symptoms of the test meal and X ray will in nearly every case give a warning if not a positive proof of one or other of these complications. The dangers of the operation itself are relatively slight. Unquestionably the greatest danger today in upper abdominal operations is the onset of lung conditions due to the use of deep anaesthesia and the difficulties of arranging for adequate surroundings during the recovery period at a large hospital. It is hence found that private operations have a much lower incidence of bronchopneumonia and pneumonia than is found with hospital patients. If care be taken in the opera-

tive treatment there should never be any possibility of postoperative haemorrhage or leakage. The risk of mechanical obstruction at the site of the gastro-enterostomy is today reduced to a minimum and is only likely to occur if the mesocolon is scarred and thickened and the colon itself bound down. In such cases the difficulty can generally be overcome by making the anastomosis anterior retrocolic or even anterior around the colon. Acute postoperative dilatation of the stomach is a very rare complication and can usually be successfully treated. The danger of recurrence of ulceration at the site of excision which is very great when simple excision alone is practiced is almost wholly eliminated by combining the treatment of the ulcer with posterior gastro-enterostomy.

### PREPARATION OF THE PATIENT

It is essential that every patient who is to have any upper abdominal operation has a period of rest in bed before this is performed and nothing is to be more greatly deprecated than the custom which is sometimes carried out of admitting a patient to the home or hospital the evening before operation. Hospital patients are usually admitted 4 days before operation, during which period a careful history is taken and the X ray and test meal investigations are carried out. With private patients such investigations are usually performed before admission to the nursing home. They are, however, admitted and kept in bed at least 36 hours before operation. Provided there has been no excessive pain nor any haemorrhage they are allowed such diet as they can conveniently take without increasing their symptoms up to midday. In the evening only a little Benger's food or milk diet is given. At about 5 a.m. on the morning of the operation which is performed at 9 a.m. 3 to 4 ounces of meat broth is administered and a hypodermic injection of  $\frac{1}{100}$  grain of atropine given at 8.15 a.m. The previous habit of strongly purging the patient is

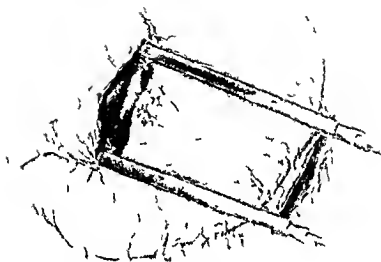


Fig. 1. Clamps in position and incision outlined.  
*Operation for Gastric Ulcers of the Lesser Curve — J. J. Walton*



Fig 4 The peritoneal surfaces of the posterior wall of stomach are sutured with running suture of catgut

ening of the lesser curve the induration of the lesser omentum speckling and scarring on the surface of the stomach and the presence of a pit into which the finger can be inserted by invaginating the anterior wall of the stomach. Should the ulcer not be found on the lesser curve or anterior surface an opening is made through an avascular area of the gastrosplenic omentum and the posterior surface of the stomach explored. In this way a posterior ulcer will not be overlooked. During this investigation a search is made for the presence of any peritoneal nodules or hard glands such as might indicate the presence of early carcinoma. An opening is now made in the lesser omentum above the ulcer and the coronary artery ligatured both above and below the ulcer. One blade of a clamp is passed through the opening in the gastrosplenic omentum and out through the opening in the lesser omentum. It is clamped well above the ulcer. A second clamp is placed in a similar manner below the ulcer.

Should the ulcer be adherent to the pancreas it is freed from the surface of this structure by careful dissection. If it is deeply penetrating this procedure will open up the cavity of the stomach but since the clamps have been applied on either side of the ulcer but little leakage will take place and the escaping fluid can be mopped up at once. A gauze pad is now passed beneath the stomach and between the two clamps and the ulcer with a wide area of surrounding stomach

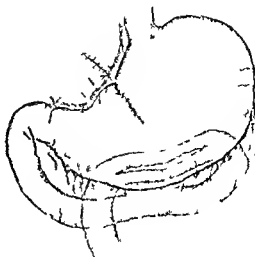


Fig 5 Wound sutured pylorus embedded with running mattress suture and gastroenterostomy indicated

excised in a wedge shaped form. The wedge of the anterior wall of the stomach is usually made first so that the limits of the ulcer can be clearly appreciated. When the excision of the posterior wall is completed the whole of the ulcer and a surrounding margin of healthy tissue is completely removed.

Forceps are applied at the apex of the V shaped opening posteriorly and by lifting this up the peritoneal surfaces of the posterior wall of the stomach are easily seen and are sutured together with a running suture of catgut which terminates and is tied at the lesser curve. A second suture is passed through all thicknesses of the posterior wall and this also is tied at the site of the lesser curve. The opening in the anterior wall is sutured in a similar manner the first row of sutures passing through all three layers of the stomach and the second through the serous and muscular coats only. When the latter suture reaches the lesser curve it is tied not only to the first suture which passed through the seromuscular coat but is made to pick up the divided edges of the gastrosplenic omentum so that when it is tied these are approximated and the line of suture of the stomach is covered along the lesser curve. The clamps are now removed and should there have been a raw area left on the surface of the pancreas this is embedded with a few catgut sutures through the opening in the gastrosplenic omentum. The stomach is now pulled over to the patient's left and the pylorus

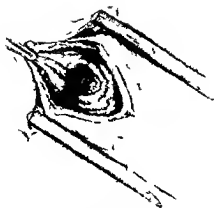


Fig. 2. The anterior wedge of lesser curve is excised first so that the limits of the ulcer can be seen.

now abandoned. Provided the bowels have been regularly opened no drug at all may be required but if necessary a small dose of aperient may be given on the evening of admission. The choice of such aperient is usually left to the patients so that they will take only a drug to which they are accustomed. If the result obtained by its use is not very satisfactory an enema is administered on the evening previous to the operation.

On the same evening the pubes and if necessary the whole of the abdominal wall are shaved. The whole abdomen from just below the nipple line to the pubes is painted with iodine and wrapped in a sterile towel. In hospital patients when the skin is less clean it may be necessary before this is carried out to cleanse the surface thoroughly with soap and water special attention being given to the umbilicus. Early on the morning of the operation a second coat of iodine is applied, and a third while the patient is on the table. For 48 hours previous to the operation all smoking is prohibited.

#### TECHNICAL STEPS OF THE OPERATION

Anæsthesia is as a rule induced with open ether and is continued either with ether on an open mask or with warmed ether vapor. Prolonged gas and oxygen anæsthesia is used only in exceptional cases and local anæsthesia only in patients who are severely ill such as in cases of perforation or severe hæmorrhage.

The last coat of iodine having been applied and the towels clipped in position an incision is made about 6 inches in length. It lies 1 inch to

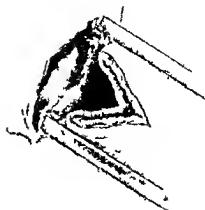


Fig. 3. Excision of ulcer-bearing area completed.

the right of the midline and starts above just over the costal margin and passes down to the level of the umbilicus. As soon as the skin and subcutaneous tissues are divided two large gauze pads are clamped to either side of the incision with curved forceps and clipped together above and below the wound. Hence the surface of the skin is entirely excluded from the operation. The anterior sheath of the rectus is divided in the line of the skin incision and the inner flap of aponeurosis reflected inward until the inner edge of the rectus is reached. This muscle is retracted outward and the posterior sheath divided in the same line as the anterior sheath. In patients with a very poor abdominal wall or in whom the posterior sheath is very thin a transverse incision in the line of its fibers is made 4 to 5 inches long instead of the vertical incision. This p.-s. rectal incision is now used practically as a routine for all operations upon the stomach gall bladder duodenum and pancreas.

A hand is inserted into the peritoneal cavity and the appendix—and in females the uterus and ovaries—rapidly examined. If these are found to be normal the gall bladder and pancreas are investigated and also the duodenum. Any complication is much less likely to be overlooked if it is searched for before the attention is fixed upon the lesion which is known to be present.

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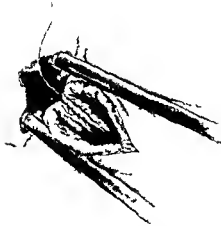


Fig 4 The peritoneal surfaces of the posterior wall of stomach are sutured with running suture of catgut

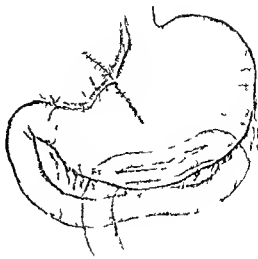


Fig 5 Wound sutured pylorus embedded with running mattress suture and gastro-enterostomy indicated

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Fig 2 The anterior wedge of lesser curve is excised first so that the limits of the ulcer can be seen

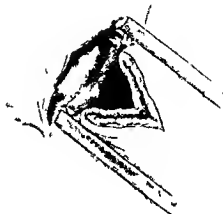


Fig 3 Excision of ulcer-bearing area completed

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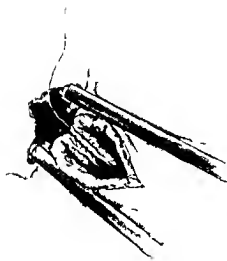


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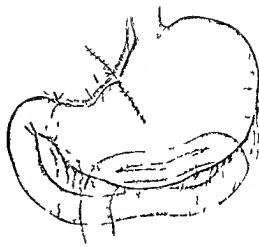


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Fig. 2. The anterior edge of lesser curve is excised first so that the limits of the ulcer can be seen.

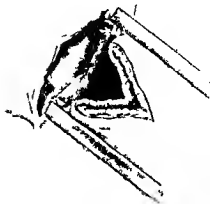


Fig. 3. Excision of ulcer bearing area completed.

now abandoned. Provided the bowels have been regularly opened no drug at all may be required but if necessary a small dose of aperient may be given on the evening of admission. The choice of such aperient is usually left to the patients so that they will take only a drug to which they are accustomed. If the result obtained by its use is not very satisfactory an enema is administered on the evening previous to the operation.

On the same evening the pubes and if necessary the whole of the abdominal wall are shaved. The whole abdomen from just below the nipple line to the pubes is painted with iodine and wrapped in a sterile towel. In hospital patients when the skin is less clean it may be necessary before this is carried out to cleanse the surface thoroughly with soap and water. Special attention being given to the umbilicus. Early on the morning of the operation a second coat of iodine is applied and a third while the patient is on the table. For 48 hours previous to the operation all smoking is prohibited.

#### TECHNICAL STEPS OF THE OPERATION

Anæsthesia is as a rule induced with open ether and is continued either with ether on an open mask or with warmed ether vapor. Prolonged gas and oxygen anæsthesia is used only in exceptional cases and local anæsthesia only in patients who are severely ill such as in cases of perforation or severe hæmorrhage.

The last coat of iodine having been applied and the towels clipped in position an incision is made about 6 inches in length. It lies 1 inch to

the right of the midline and starts above just over the costal margin and passes down to the level of the umbilicus. As soon as the skin and subcutaneous tissues are divided two large gauze pads are clamped to either side of the incision with curved forceps and clipped together above and below the wound. Hence the surface of the skin is entirely excluded from the operation. The anterior sheath of the rectus is divided in the line of the skin incision and the inner flap of aponeurosis reflected inward until the inner edge of the rectus is reached. This muscle is retracted outward and the posterior sheath divided in the same line as the anterior sheath. In patients with a very poor abdominal wall or in whom the posterior sheath is very thin a transverse incision in the line of its fibers is made 4 to 5 inches long instead of the vertical incision. This pararectal incision is now used practically as a routine for all operations upon the stomach gall bladder duodenum and pancreas.

A hand is inserted into the peritoneal cavity and the appendix—and in females the uterus and ovaries—rapidly examined. If these are found to be normal the gall bladder and pancreas are investigated and also the duodenum. Any complication is much less likely to be overlooked if it is searched for before the attention is fixed upon the lesion which is known to be present.

The stomach is then drawn out of the wound and the lesser curve examined. The ulcer is usually evident on account of the localized thick

extract in 1 dram of water every 6 hours for 6 doses. This drug was first given to control the loss of altered blood which was found in a case with dilatation and it was seen that not only was the hemorrhage stopped but the action of the stomach was enormously improved. Should there be no relief by these measures the case must be regarded as one of mechanical obstruction and further operation considered. It must always be remembered however that such a complication should be prevented by correct operative technique rather than by the introduction of treatment after operation.

In uncomplicated cases the diet is gradually increased. On the second day a little jelly or junket may be added to the fluid which is administered by mouth the quantities of which may be increased from 1 to 2 ounces at a time. On the third day a lightly boiled egg may be given and on the fourth day a little thin bread and butter without crust may be added. At this time Bengers food, boiled custard and a few grapes may be allowed after which time the diet is gradually increased by the addition of pounded fish, lightly boiled fish, thin slices of chicken, etc. up to a full diet. At the end of a week the patient is taking a full and mixed diet but it is important that the meals should be small and frequently repeated. A large quantity is more likely to give rise to symptoms than a variation in the quality.

On the evening of the second day a soap and water enema is given or if there has been much distention and discomfort this may be administered even on the day after operation but it is well to remember that the patient is much better if the bowels are given complete rest. The custom which is still sometimes advocated of giving the patient a large dose of castor oil on the third day after the operation is much to be deprecated. The use of so drastic a drug is quite unnecessary and often harmful. After the enema has acted a mild aperient containing a little magnesium and sodium sulphate should be given in small doses.

The stitches are not removed until the tenth day and on the eleventh day the patient is allowed out of bed for 5 minutes. At the same time the use of bismuth and an alkali is commenced, a prescription containing 10 grains of bismuth carbonate, magnesium carbonate and sodium bicarbonate is given 3 times a day and the use of this is continued regularly until 3 months after the operation. The patient is allowed out of bed for increasing periods of time each day and is advised to go away for a 2 or 3 weeks holiday after the operation. He is permitted to leave the hospital on about the sixteenth day.

#### GENERAL REMARKS IN PROGNOSIS

By such a method the operative mortality is found to be relatively low and should not exceed 2 per cent and even these figures will include the larger and more severe examples of ulcer. 90 per cent of the remaining patients will be completely cured and free from all symptoms of the remainder the majority may have infrequent attacks of vomiting and discomfort and this is found practically wholly in women who are suffering from viceroposis in addition to the lesser curve ulcer, a combination which is not uncommon. The symptoms are in fact due to the ptosis and not to any evil results of operation. Of after complications gastrojejunal ulcer may be said never to occur in this type of lesion. The onset of carcinoma is very unusual. One case in my series developed later, a pyloric carcinoma and another a carcinoma at the site of excision, this however occurred relatively soon after operation and was probably present at the time of the operation. In the later series more careful investigation of the symptoms and of the test meal has given rise in several cases to a suspicion of early carcinoma and in these a partial gastrectomy has been performed instead of the excision. It is very probable then that the onset of carcinoma at a later date is due to an error of diagnosis and its occurrence should have been prevented by the use of other operative measures.

embedded with a running mattress suture of silk so as to bring about a temporary occlusion.

X-ray investigation in the Follow up Department has shown that this temporary occlusion does not persist for more than 2 months after which the pylorus opens again.

A posterior no-loop gastro-enterostomy is now performed a portion of the jejunum being brought up through the mesocolon and anastomosed in the ordinary manner with the stomach. The opening into the stomach is placed differently from that of an ordinary gastro-enterostomy. It is made to run transversely as close as possible to the greater curvature and is so placed that one half is proximal and the other half distal to the sutured line of excision. By this means neutralization of the acid content is carried out high up in the stomach and should any hourglass constriction follow the excision of the ulcer—a complication which I have never known to occur—both pouches of the stomach would be drained by the gastro-enterostomy. The anastomosis is performed in the usual way all the sutures being of catgut and consisting of two layers the first passing through the seromuscular coats and the second through all three layers. The opening of the mesocolon is now sutured to the posterior wall of the stomach close to the anastomosis in the usual way and the viscera replaced.

The abdominal wall is closed with a series of sutures all of which are of catgut. The first passes through the peritoneum and posterior sheath a running mattress suture being used which is passed from within on the right side and from without on the left side. By this means the two layers are made to overlap the right half lying superficially to the left. Not only does this give a firmer grip of the structures so that the suture is less likely to cut out during the process but by giving two surfaces in apposition it is thought that a firmer union occurs. Since its adoption 9 or 10 years ago no case of incisional hernia has occurred in the author's practice. The rectus is stitched into place with a single catgut suture, and the anterior sheath united by a simple running catgut suture the skin being united by silkworm gut sutures. In very stout patients a few tension sutures which pass through the skin anterior sheath and muscle may be used but they are not inserted as a routine practice. A simple gauze dressing is then applied.

#### POSTOPERATIVE CARE

The patient after being returned to bed is allowed to lie upon one or the other side. As soon as he begins to come round he is given a hypo-

dermic injection of  $\frac{1}{4}$  grain morphine and  $\frac{1}{100}$  grain atropine and for the first 24 hours small sips of water are allowed by mouth. As soon as he is well round he is propped up and the convalescence in the first 2 days is carried out in the sitting posture. For the first 24 hours morphine is given as often as may be necessary to keep the patient comfortable for it is not thought that the use of this drug gives rise to any complications but greatly helps the postoperative comfort of the patient. For the first 24 hours the room is kept very warm and the windows closed for there is no doubt that by such a method the danger of postoperative lung complications is much diminished and it is in this respect that the ventilation which is necessary for a general ward is found so unsatisfactory in the postoperative stage. While the patient is sitting propped up it is generally necessary to keep him in position by the use of a knee pillow. Since the pressure of such may tend to the development of postoperative thrombosis the patient is encouraged to move his legs as much as possible. On the morning after the operation that is some 24 hours later the patient is allowed a small cup of tea about 1 to 1½ ounces and during that day is given feeds of a similar quantity consisting of diluted milk tea or even a little chicken broth.

Very frequently these cases show no postoperative vomiting but if there has been any difficulty with the anæsthetic it is likely to be present. In such cases small doses of iced champagne of 1 to 2 drams in quantity will often give considerable relief. Actual obstructive vomiting the so-called vicious circle is today very rare and is probably due in most cases to constriction of the opening in the mesocolon. Its presence is the more rather an indication of an error in technique, and is due to the fact that a posterior gastro-enterostomy has been performed on a patient who has a fat or adherent mesocolon or that the opening of the mesocolon has not been sutured to the stomach sufficiently far from the anastomosis. In all such cases it would have been better to have performed an anterior gastro-enterostomy. Sometimes this rare complication may be temporary and due probably to an œdema of the opening of the mesocolon rather than to a mechanical obstruction. Therefore should frequent vomiting of large quantities persist after 24 hours treatment should first be carried out in the belief that the condition is due to such œdema before further operative treatment is considered.

The stomach should be washed out and the patient should be given 2 dram doses of suprarenal

Fig. 1 Small instrument with which surgeon massages anterior capsule of lens to hasten maturity

body. Then a special eye drape of dark green cloth is placed over the head. This cloth 90 centimeters square has an oval opening approximately 7 by 14 centimeters through which the surgeon operates. Immediately before the speculum is inserted several drops of adrenalin and 4 per cent cocaine are instilled into the eye to be operated upon.

After the speculum has been inserted the eye is grasped with fixation forceps below the cornea and the keratome is inserted at the limbus in the midline above. The knife is passed well across the anterior chamber making a good wide incision. As it is withdrawn the iris usually follows it with the escape of aqueous. The prolapsed iris is withdrawn through the wound and excised in the usual manner. The surgeon inserts a small instrument (Fig. 2) with which he massages the anterior capsule of the lens to hasten its maturity. The pillars of the coloboma are replaced and the speculum removed. The eye is dressed by putting a small amount of 1 per cent atropia salve into the conjunctival sac toward the outer canthus and by completely filling the remaining portion of the sac with 1 to 1000 bichloride salve. Both eyes are bandaged and Ring's ocular mask applied. A stretcher is brought into the operating room and after the table has been adjusted to the same height as the stretcher the patient is transferred by four assistants one at the head one at the foot and one on either side of the canvas band passing beneath the patient's back. This transfer to the stretcher is made without the slightest bit of effort on the part of the patient.

#### POSTOPERATIVE ORDERS

1. The patient is to remain flat on his back in bed for 5 hours.
2. The diet for 24 hours is to be liquid.
3. Bowels are to be moved 48 hours after operation.
4. All brilliant daylight is excluded; the room to be illuminated by a specially constructed floor lamp placed beneath the bed.
5. The patient is to have 20 grains of sodium bromide if discomfort should arise.
6. The house surgeon is to be called if the patient should have any discomfort.

On the day following the operation the surgeon removes the bandage taking every precaution not to hurt the patient lest the patient should

Fig. 2 Instrument used to extract lens

squeeze the eyelids together and injure the eye. For this reason the silk adhesive which holds the eye bandage in place is soaked off and *never pulled*. The eyelid is carefully opened by the surgeon and his assistant who instruct the patient not to make any voluntary movements whatever. The cornea is examined with candle light only. A 10 per cent solution of argyrol is instilled into the lower conjunctival sac and allowed to remain there 2 minutes after which the eye is irrigated with boric solution. The lower cul de sac is then filled with atropia and bichloride salve the skin around the eye gently wiped with boric acid solution and an eye pad and bandage applied to the eye operated upon leaving the good eye free. This dressing is continued until the seventh day after the operation. On the eighth or ninth day the patient is discharged from the hospital with the following instructions:

#### DIRECTIONS FOR MR. X

1. Three times a day one or two drops of boric acid solution should be instilled into the eye that has been operated upon.
2. Atropia 1% to be used only in case of irritation.
3. Be very careful about exposing the eye operated upon to bright light or wind. The other eye should be used only for the most necessary things.
4. Three weeks after the preliminary iridectomy the patient can return to the hospital for removal of the cataract.
5. In case the eye should give any trouble immediately consult an oculist or take the first train for the Institute.

When the patient returns to the hospital an interval history is taken in which everything of importance is noted. Conjunctival scrapings and culture are taken, urinalysis and blood count are made and the patient is prepared for operation on the following day in the same manner as for preliminary iridectomy but in addition the pupil is dilated by atropine.

#### EXTRACTION

The patient walks to the operating room having received 20 grains of sodium bromide and  $\frac{1}{2}$  grain of codeine 15 minutes previously. After being comfortably placed on the operating table with a rubber sheet across the lumbar region to prevent postoperative discomfort the eyes are scrubbed for the third and last time with green soap and

## FROM THE WILMER CLINIC OF JOHNS HOPKINS HOSPITAL

## IMMATURE CATARACT OPERATION FOR USE WHEN INTRACAPSULAR EXTRACTION SEEMS INADVISABLE

BY CECIL H. BAGLEY, M.D., BALTIMORE, MARYLAND

Revised October 1904

**E**LDERLY people with immature cataracts are often advised to postpone any operation until the lens is completely opaque. But frequently relatively young people have partial cataracts which require many years to mature. In such cases Dr. Wilmer performs a preliminary iridectomy with massage of the anterior capsule of the lens, followed by an extraction 3 weeks later. While the iridectomy does add an operative procedure it possesses some distinct advantages. In addition to hastening the maturity of the lens it enables the operator to discover any drug idiosyncrasy in the patient (atropine, mercuric bichloride, etc.) and it teaches the patient the proper operative and post-operative behavior.

A careful general examination is made which includes blood chemistry (especially in regard to blood sugar), white blood count, hemoglobin, coagulation time, phthalein determination, urinalysis, nose and throat tests, basal metabolic rate and lens sensitivity test. The last mentioned is regarded as most important, especially in cases of immature cataract when there is a possibility of any soft lens matter being left behind. If patients are found sensitive to lens protein they are desensitized by repeated doses of increasing strength until immunity is produced.

After all sources of toxemia, focal infection, or conditions which reduce tissue resistance are excluded or improved the patient is admitted to the hospital the day before operation.

## PRE-OPERATIVE TREATMENT

In every intra-ocular operation a scraping is taken from the conjunctival sac from which a culture and smear are made to determine the organisms present. Ten per cent argyrol instillation into the cataractous eye is followed by boric acid irrigation every 2 hours. At 7:00 p. m. on the day preceding operation the house surgeon goes to the patient's room and instills 2 drops of 1 per cent butyn into each eye. He then instructs the patient to close the eyes while he gently scrubs the entire face and eyelids with green soap for 5 minutes, working up a good lather over the entire face. This is then washed off with 1:10,000

bichloride and sterile water and the eyes irrigated with boric solution. The upper lashes are coated with 1:10,000 lithium chloride salve and then trimmed close to the lid margin with small straight scissors. The salve is used to keep the lashes from getting into the eye. Following this the eye is again irrigated with boric acid. The conjunctival sac is completely filled with 1:10,000 bichloride salve and the eye bandaged for the night. Orders are then given for a mild cathartic such as phenolax. It has been found very necessary that the patient should have a good night's sleep before the operation. For this reason mild sedatives such as sodium bromide, luminal or allonal are prescribed if necessary.

At 6:00 a. m. on the day of the operation the patient is given a soap-suds enema. At 7:30 a. m. a slice of toast and a cup of tea. At 8:00 a. m. the house surgeon removes the dressing, instills 10 per cent argyrol followed by boric irrigation, then instills one drop of 1 per cent butyn into each eye. Gentle pressure is applied to the lacrimal sac to evacuate any possible content through the canal and the patient's face is again scrubbed with green soap for 5 minutes. This is followed by bichloride and sterile water. The eyes being thoroughly irrigated. A sterile eye pad is then placed over the eye until 8:30 a. m. when the patient is given 20 grains of sodium bromide and 1/2 grain of codeine by mouth and the nurse in charge begins the 1 per cent butyn drops in the cataractous eye continuing the drops every five minutes until 9:00 a. m. at which time the patient is taken to the operating room.

## PRELIMINARY IRIDECTOMY

The patient walks to the operating room. One drop of 1 per cent butyn is instilled into the eye that is not to be operated upon. This is done to keep the eye from irritating the eye. For the third time the face is scrubbed with green soap for 3 minutes and rinsed with 1:10,000 bichloride and sterile water. 1 cubic centimeter of 1:100 procaine with adrenalin is injected subconjunctivally below the cornea of the eye to be operated upon. The patient is draped with lead to shield and a large sheet which covers the entire

Fig 1 Small instrument with which surgeon massages anterior capsule of lens to hasten maturity

body. Then a special eye drape of dark green cloth is placed over the head. This cloth 90 centimeters square has an oval opening approximately 7 by 14 centimeters through which the surgeon operates. Immediately before the speculum is inserted several drops of adrenalin and 4 per cent cocaine are instilled into the eye to be operated upon.

After the speculum has been inserted the eye is grasped with fixation forceps below the cornea and the keratome is inserted at the limbus in the midline above. The knife is passed well across the anterior chamber making a good wide incision. As it is withdrawn the iris usually follows it with the escape of aqueous. The prolapsed iris is withdrawn through the wound and excised in the usual manner. The surgeon inserts a small instrument (Fig 2) with which he massages the anterior capsule of the lens to hasten its maturity. The pillars of the coloboma are replaced and the speculum removed. The eye is dressed by putting a small amount of 1 per cent atropia salve into the conjunctival sac toward the outer canthus and by completely filling the remaining portion of the sac with 1 to 1000 bichloride salve. Both eyes are bandaged and Ring's ocular mask applied. A stretcher is brought into the operating room and after the table has been adjusted to the same height as the stretcher the patient is transferred by four assistants one at the head, one at the foot and one on either side of the canvas band passing beneath the patient's back. This transfer to the stretcher is made without the slightest bit of effort on the part of the patient.

#### POSTOPERATIVE ORDERS

- 1 The patient is to remain flat on his back in bed for 5 hours.
- 2 The diet for 24 hours is to be liquid.
- 3 Bowels are to be moved 48 hours after operation.
- 4 All brilliant daylight is excluded the room to be illuminated by a specially constructed floor lamp placed beneath the bed.
- 5 The patient is to have 20 grains of sodium bromide if discomfort should arise.
- 6 The house surgeon is to be called if the patient should have any discomfort.

On the day following the operation the surgeon removes the bandage taking every precaution not to hurt the patient lest the patient should

Fig 2 Instrument used to extract lens

squeeze the eyelids together and injure the eye. For this reason the silk adhesive which holds the eye bandage in place is soaked off and *never pulled*. The eyelid is carefully opened by the surgeon and his assistant who instruct the patient not to make any voluntary movements whatever. The cornea is examined with candle light only. A 10 per cent solution of argyrol is instilled into the lower conjunctival sac and allowed to remain there 2 minutes after which the eye is irrigated with boric solution. The lower cul de sac is then filled with atropia and bichloride salve, the skin around the eye gently wiped with boric acid solution and an eye pad and bandage applied to the eye operated upon leaving the good eye free. This dressing is continued until the seventh day after the operation. On the eighth or ninth day the patient is discharged from the hospital with the following instructions:

#### DIRECTIONS FOR HOME

- 1 Three times a day one or two drops of boric acid solution should be instilled into the eye that has been operated upon.
- 2 Atropia is to be used only in case of irritation.
- 3 Be very careful about exposing the eye operated upon to bright light or wind. The other eye should be used only for the most necessary things.
- 4 Three weeks after the preliminary incision the patient can return to the hospital for removal of the cataract.
- 5 In case the eye should give any trouble immediately consult an oculist or take the first train for the Institute.

When the patient returns to the hospital an interval history is taken in which everything of importance is noted. Conjunctival scrapings and culture are taken, urinalysis and blood count are made and the patient is prepared for operation on the following day in the same manner as for preliminary incision, but in addition the pupil is dilated by atropine.

#### EXTRACTION

The patient walks to the operating room having received 20 grains of sodium bromide and  $\frac{1}{2}$  grain of codeine 15 minutes previously. After being comfortably placed on the operating table with a rubber sheet across the lumbar region to prevent postoperative discomfort the eyes are scrubbed for the third and last time with green soap and



irrigated with bichloride and sterile water. The innervation of both the upper and lower lids is then blocked by subcutaneous infiltration of both lids with 1 cc procaine containing 4 minims of adrenalin to the ounce. This is considered a most important step in cataract extraction as it prevents the patient's closing the eyelids or exerting any pressure on the eyeball after section has been made which might result in the loss of vitreous. This injection in addition to the butyn every 5 minutes for  $\frac{1}{2}$  hour preceding operation and 20 grains of sodium bromide gives complete anesthesia and relaxation no pain whatever being experienced during the operation. Just before the speculum is inserted the patient is requested to look to the right to the left up and down and is told that during the operation he is to think before moving the eye when requested and not under any condition to move it except when requested.

The section includes the upper two-fifths of the cornea at the limbus, having a conjunctival flap of 2 to 3 millimeters at the top. At this step the speculum is removed and a Fischer's hook inserted beneath the upper lid, where it is held in place by an assistant. This lifts the lid entirely away from the eye giving good exposure and taking the weight of the lid from the incised eyeball. After the Fischer's hook is properly placed a capsulotomy is passed through the incision and a portion of the anterior capsule of the lens is removed.

Through this opening in the anterior capsule the lens comes forward against the posterior surface of the cornea. Gentle pressure is then made by an instrument (Fig. 2) at the limbus below and the lens is extracted. When the cataract is completely matured there is no soft lens matter remaining behind the pupil looks perfectly clear and black and generally there is no need for irrigation of the anterior chamber though occasionally it is found necessary. The pillars of the iris are carefully replaced by a small thin spatula to prevent any incarceration of the structures in the wound. The Fischer's hook is removed and the lids carefully closed over the eyeball. A small amount of 1 per cent atropia salve is placed in the lower cul de sac toward the external canthus the conjunctival sac is filled completely with 10,000 bichloride salve both eyes are bandaged and Ring's ocular mask applied. The patient is returned to the ward on stretcher with the same orders as those issued after preliminary incision.

On the following day, the surgeon in charge removes the bandage from the eye operated upon the lids are not opened but are inspected externally and if there is no swelling or secretion he is reassured that everything beneath is going well. The skin about the eyelids is gently cleansed with boric acid solution a small amount of 1 per cent atropia salve is applied along lid margins, and both eyes are again bandaged.

On the third day after operation the dressing is removed and lids are inspected but this time the lower lid is pulled down just a trifle so that the lower cul de sac may be seen a drop of 10 per cent argyrol is instilled into the cul de sac and irrigated out with boric acid solution the cornea not being exposed. The patient is still on liquid diet to prevent the muscles of mastication from causing any undue pressure on the eyeball. For the same reason he is not allowed to smoke.

On the fourth day the lid are very gently pulled apart by the surgeon and his assistant the patient remaining absolutely passive during this procedure. The cornea is then seen for the first time and the conjunctiva at this dressing appears practically normal. Ten per cent argyrol is instilled into the eye and irrigated out with boric acid solution. Atropia and bichloride salve are placed in the lower cul de sac and the eye dressed. The patient is allowed to sit up out of bed for an hour in the morning and an hour in the afternoon. A soap-suds enema is given and he is put on medical soft diet. The eye operated upon is bandaged 7 days and its fellow 4 days. The patient is usually discharged from 9 to 14 days after the operation with the following instructions and advised to return to the Institute 6 weeks later for refraction if possible.

#### DIRECTIONS FOR MEDICATION

1. Four times a day 30 cc of 1 per cent boric acid solution (the large bottle) should be instilled into the eye operated upon.
2. Every morning one or two drops of the atropia solution (the smaller bottle) should be put into the eye operated upon in case there is any irritation.
3. Twice a day bathe the eye for 5 minutes with hot water followed by a dash of cold.
4. Be careful for 2 weeks about exposing the eye to bright light or wind. Dark glasses should be worn in all bright light and a pad should be put over the eye if exposed to wind or dust.
5. The good eye should not be used for anything for week.
6. If there should be any trouble with the eye immediately consult an oculist or take the first train for the Institute.

FROM THE OBSTETRICAL CLINIC CHICAGO LYING-IN HOSPITAL

## THE PRINCIPLES OF THE TECHNIQUE OF THE SECOND STAGE OF LABOR

By J B DELEE MD FACS CHICAGO

**D**URING the few hours comprising the second stage of labor many babies and not a few mothers die and many invalids mostly permanent are made. It is imperative therefore that the accoucheur be in personal attendance on the parturient or be represented by a competent assistant as soon as the cervix is completely dilated that is the second stage is begun and that he remain by the patient's side until the labor is completed.

The duties of the obstetrician during this critical period may be classed under 5 headings: (1) protecting the parturient from infection; (2) preventing injury; (3) relieving her of excessive pain; (4) preserving the life and health of the child; (5) preventing complications. While the average practitioner will obtain a certain measure of success in the routine treatment of the labor case, he will require more than the usual amount of brains and of skill to perform all these duties well and pilot the mother and baby safely through the perils which menace both from all sides. The accoucheur will therefore need to devote all his time and all his talents to the mother and baby during this period of labor.

Protecting the parturient from infection consists not alone in carrying out in the minutest detail the principles of asepsis and antiseptics but in so fortifying the woman's system that she can and will throw off any invading army of bacteria.

It should be and probably would be insulting to the reader if I were to say that he must conduct a labor with the same painstaking regard for asepsis and antiseptics as that practiced by the surgeon in the surgical operating room. Vital statistics show that over 5,000 women die of puerperal infection every year in the United States. It is therefore needful to say that the parturient woman requires and deserves an even more perfect aseptic technique. Each labor should be conducted with the same care as that used in a vaginal hysterectomy. Obstetrical cases in general hospitals are especially apt to become infected and therefore need particular isolation and isolation is permanently effectual only with architectural separation of the maternity from the general medical and surgical wards.

Fortifying the system against bacterial invasion involves the proper preparation of the gravida for her ordeal and the conduct of the long first stage of labor so as to avoid dehydration, starvation, acidosis and nervous and physical exhaustion. It also means proper conduct of the delivery itself so as to prevent first and most important loss of blood, even minimal amounts, second exhaustion from prolonged natural effort, third shock, mental and physical, fourth undue traumatism, natural and artificial.

I cannot discuss all these important things in detail. By preparing the gravida I mean that throughout pregnancy the woman should be made to exercise and to eat properly, she should be watched for focal and general infections, heart, kidney diseases, etc., and all such conditions corrected as far as possible—in short, adequate prenatal care should be given her. During labor, food, water, rest and mental encouragement are to be provided. The second stage should not be allowed to drag on indefinitely, but the watchful accoucheur should determine not what nature can endure but what she can accomplish.

Long before the first labor pain has occurred the attendant must have made up his mind whether or not the case is a normal one as far as mechanical disproportion is concerned. Prolonged pounding of the head against the inlet or the pelvic floor results in traumatism which invites infection but improperly performed delivery by the accoucheur will cause more damage and give rise to more infection than natural delivery. Besides an obstetrician who does not know how to operate usually also does not know how to be clean, that is does not carry out a perfect aseptic technique. Unless therefore the attendant really can improve on nature he had better leave her alone and interfere only in the presence of immediate danger to mother or child. In all necessary operations traumatism of the tissues should be reduced to an insignificant minimum. Healthy tissues resist infection. Traumatized structures invite its entrance. The Latin motto which the old accoucheurs engraved on their forceps should be respected.

*Non Vis—Sed Arde*

There is a curious superstition that a patient can and should lose blood during labor and that a bloodless labor while not harmful is abnormal. I would prefer all labors to be bloodless being certain that the women would have less post partum infections, nurse their babies better, and recover their strength much quicker. It is wise therefore during the second stage to preserve the woman's blood reserve intact—she will always lose more than is good for her in the third stage.

*Prevention of injury* in addition to its guarantee against infection safeguards the woman's future health. The connective tissue and fascial supports of the cervix bladder vagina rectum and pelvic floor must be preserved or else the woman will suffer in later years from greater or less degrees of prolapse of the pelvic organs. A certain amount of damage is inevitable during the passage of the child especially in women of the enteropneustic type those with a congenital weakness of all mesoblastic structures. In the women all we can give is the perineum and not always that. Cervical tears while common in operative deliveries occur frequently in spontaneous labors and the same applies with greater force in respect to the pelvic floor.

Reduction of such damage is effected by allowing the natural powers to bring the head down to and between the levator ani pillars. The bearing down efforts of the woman instead of being spurred on by the attendant as is generally done are to be restrained and moderated by instructing the parturient how best to use her powers or by the judicious employment of anaesthetics. Urging the parturient to bear down incontinently is too often an evidence of the attendant's desire to hurry the labor and curtail his expenditure of time rather than an evidence of the exigencies of the case. A slower dilatation of the parturient passage would be better for the soft parts and the baby's brain.

The obstetrician should understand the natural mechanism of labor and should closely observe its development by abdominal and rectal examination in each particular case. He should know how to direct the powers of labor to the best advantage by external measures for instance how to favor anterior rotation of the occiput how to deliver the head and shoulders with their smallest diameters presented to the girdle of resistance. In short he must be an obstetrician not a midwife watching a horse.

One of the greatest crimes against the integrity of the pelvic connective tissues and the baby's brain and life is the routine use of pituitrin to hasten the second stage of labor. I am not sure

that a parent could not recover damages at law if it were proved that a baby was lost or the mother injured by her attendant administering pituitrin in an apparently normal labor.

A timely episiotomy will often save the perineum from more extensive damage and at the same time relieve the baby's head from injurious pressure while in the hands of an expert obstetrician protected by the ponderous aseptic technique of the special maternity the forceps may occasionally be used to effect delivery with a minimum of danger to both mother and child. It will bear repetition however that those hands into which the majority of labor fall will do less damage to mothers and babies if they are kept off until nature shows some signs of being unable to bring the case to a happy conclusion.

*The relief of pain during the second stage* is one of the prime duties of the accoucheur. It is true that all anaesthetics carry some degree of danger to both mother and baby but on the whole the advantages outweigh this. The prevention of psychic shock is one of them and the restraining of too powerful expulsive efforts is another. It was stated above that too rapid delivery is undesirable.

There are several claimants for favor in the field. Chloroform still has many advocates but obstetricians are giving it up one by one as a cause of late poisoning develop in their practice. Nitrous oxide and oxygen are preferred by many who have not yet tried ethylene. Of the two gases the latter seem to be the more successful since it does not cause cyanosis is more relaxing leaves the head ache and does not cause any more bleeding. Its great inflammability is a drawback but this can be reduced to safety—almost—by using a water machine zeppelin painted and by grounding the machine patient operator and all who enter the room to get rid of static. For short deliveries in multipara—for short operations not involving much cutting and suturing ethylene may be used. My own preference is for ether throughout the second stage and for perineal repair. Rarely one can use local anaesthesia with 1/2 per cent novocain.

*The preservation of the life and health of the child* needless to say is of importance secondary only to that of the mother. But it is needful to say that in the practice of most obstetricians both the life and the health of the child are not considered as requiring any special attention on their part. At least one must so decide upon observing the neglect the child suffers before he is born and the rough handling he gets while being brought into the world. Some men never listen

to the baby's heart in the second stage and are astounded when it comes into the world dead. Others listen so infrequently that a child could die ten times between two auscultations. It is necessary in order to detect the earliest signs of fetal distress to listen to the heart every 5 minutes and in questionable cases continuously. For this purpose the accoucheur will find the head stethoscope most convenient indeed indispensable. When the fetal heart beats as low as 100 or less the child is in danger and needs to be removed and this should be done if the conditions are right.

I have seen men yank a child out of the womb with the gentleness of a coal heaver and expect the baby to live through the experience. A baby is a tender organism particularly its brain and it should be handled with great delicacy. We may by ungentle manipulation injure the brain and while life is not affected the child later may develop paralysis paresis mental disorder or deficiency. Prolonged compression of the brain by the natural forces of labor will cause as great damage as imperfect operative delivery. This must be avoided by the help of art appropriately timed. During the child's birth its eyes lungs navel intestinal canal must be securely protected against infection—not an easy task.

*Preventing complications* How few men conducting the second stage actually think of the most common possible complications! They can not even be said to be waiting for something to turn up except the exit of the baby. Abruptio placenta rupture of the uterus eclampsia cardiac collapse all occur occasionally during this period of labor and their remoteness or imminence should be promptly recognized. If the signs and symptoms of abruptio placenta suddenly appear prompt extraction will save the child—and the mother too. Obstruction to delivery leading to rupture of the uterus is easily discovered but tumultuous pains can burst a uterus even when there is no mechanical obstruction. Then deep anesthesia will save the woman's life. Cardiac disease may show itself for the first time during the second stage of labor. Many cases of obstetric shock are really cardiopathies. A close watch of the parturient's heart, which is rendered so easy by the head stethoscope would have warned the obstetrician in time.

I will conclude by quoting two very trite sayings truer nowhere than in obstetrical practice and truest and most applicable to the second stage of labor. It is always the unexpected that happens. Eternal vigilance is the price of success.

# SOME TYPES OF HARELIP AND CLEFT-PALATE DEFORMITIES AND THE OPERATIVE RESULTS<sup>1</sup>

By WARREN B. DAVIS M.D. F.A.C.S. PHILADELPHIA

**S**URGICAL literature is replete with the many varieties of operations which have been devised for the correction of harelip and cleft palate deformities. This very multiplicity probably indicates that none is entirely satisfactory. Through the courtesy of Dr. J. Chalmers DaCosta it has been our privilege during the past 10 years to have charge of the harelip and cleft palate cases admitted to Surgical Division A at Jefferson Hospital. We have utilized this opportunity to observe the relative merits of the methods impressing us as being best adapted to each type of deformity which has occurred in our series of 327 cases. Thus our technique is a composite one in which may be recognized the assembling of elements taken chiefly from the basic principles and procedures evolved by Langenbeck, J. Ewing, Mears, W. J. Roe, G. V. I. Brown, V. P. Blair, J. E. Thompson, J. S. Davis, Berry and Legg. In addition there are some modifications and variations which naturally develop as a personal element in one's surgical work.

We shall consider here a few of the varieties of deformities, briefly describe the types of operations used in their correction and show by photographic records the pre-operative conditions and the results obtained.

Incomplete and complete unilateral harelip deformities are best corrected by practically the

same general plan of treatment. In the cases in which the cleft extends only partially through the lip (Fig. 1) there is little or no muscle tissue between the superior angle of the cleft and the floor of the nostril; thus the degree of the deformity which is shown in the deviation of the nasal septum to the opposite side, the widening of the nostril and the associated flattening of the ala may sometimes approach that found in cases of complete harelip (Fig. 3). To correct these deformities and obtain the best functional results the ala must be brought into proper relation to the septum, the deviation of the septum corrected, muscle tissue approximated in the closure of the cleft, the lip made the proper length and exact alignment of the vermillion borders secured (Figs. 2 and 4).

In outlining the incisions we have found the method devised by J. E. Thompson to be most satisfactory (Fig. 5). It insures the lip being the desired length and of sufficient fullness at the margin. At the time of operation the marginal fullness may appear excessive but after a few months it is usually found to have been an allowance just sufficient to balance properly the contraction which later occurs in the suture line. In very few instances have we had excess fullness to persist, a condition which is readily corrected by a slight secondary adjustment. Incomplete clefts



Fig. 1

Fig. 1. Case 1. Infant age 7 months with incomplete unilateral harelip showing absence of muscle tissue between superior angle of cleft and floor of nostril, deviation of nasal septum and flattening of the ala.



Fig. 2

Fig. 2. Case 1 showing contour of lip and nostril 10 months after operation.



Fig. 3

Fig. 3. Case 2. Child 12 months old with unilateral harelip. Note deviation of nasal septum, flattening of ala and consequent widening of nostril.



Fig. 4

Fig. 4. Case 2 showing contour of lip and nostril 5 years after operation.

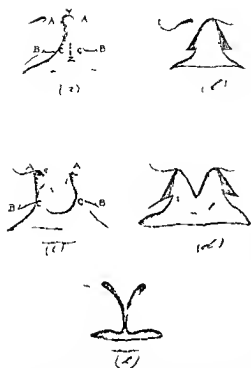


Fig 5 Semidiagrammatic sketches showing lines of incisions used for the correction of single and double hare lip (After methods of J F Thompson) In single clefts Sketch a sharp pointed calipers are used in measuring the distance IZ from the midpoint of the floor of the nostril to the point in the same sagittal plane to which the free margin of the lip would come if it were of normal contour. Fixing the distance on the calipers and keeping the superior point at I the inferior point of the calipers is rotated describing an arc which crosses the vermilion border of the lip on either side of the cleft. These points B and B' are distinctly marked by making a puncture with the point of the calipers or with a small scalpel. Points C and C' are then located on the free margin of the lip so that the angles ABC and A'B'C' are between 60 and 80 degrees. Incisions carried through the entire thickness of the lip with a small scalpel at a right angle to the skin surface and following the lines as outlined will give surfaces for approximation which are of equal length and which when sutured together will give a lip the length of which is the estimated normal length IZ plus the distance from the vermilion border to the free edge of the lip CE which is usually just sufficient to allow for subsequent contraction. Sketch b shows tissue removed. Lines of incision used in double harelip are shown in Sketch c. The philtrum is trimmed to a V-shape leaving as much tissue as is possible with thorough removal of the vermilion borders. The lateral incision lines are outlined as described for single harelip. Sketches d and e show tissues ready for approximation.

are converted into complete ones by incisions which are carried well up into the floor of the nostril where sufficient tissue is removed to allow

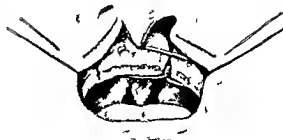


Fig 6 Sketch showing location of partial division of alveolar process to allow premaxilla to be brought into nearly normal position. The philtrum has been trimmed to a V-shape just within the vermilion borders. Temporary traction sutures are in position just above vermilion border of lip and lateral to points outlining incisions.

proper adjustment of the ala. The ala, the lip and the antero-inferior portion of the cheek must be sufficiently freed from the anterior maxillary wall to permit approximation without undue tension. Trauma to the lip and consequently the resulting scar tissue we believe is minimized by the use of temporary traction sutures placed just above the vermilion border and lateral to the outlined incisions instead of forceps (Fig 6). Special attention should be given to correcting as far as possible the deviation of the nasal septum. In infants and in young children forcibly pressing the septum over with a small Sineron nasal dilator may be sufficient since the subsequent gentle traction of the reconstructed lip and floor of the nostril tends to overcome the anterior deflection (Fig. 2). In older patients however our best results have been secured by separating the mucoperiosteum from each side of the base of the septum through an incision made transversely underneath the lip at its attachment to the antero-inferior portion of the septum and then dividing submucously with a small thin chisel the attachment of the septum to the intermaxillary ridge. This allows the septum to be placed approximately in the median line and not only improves the cosmetic result but also increases and equalizes the nasal respiratory area (Figs 20 to 22 and 27 to 30). If an obstructing septal ridge is present it should be removed submucously at a subsequent operation.

In cases with both harelip and cleft palate we do the operation in two stages closing the alveolar



Fig 7



Fig 8



Fig 9



Fig 10

Fig 7 Case 3 Infant age 5 months with complete unilateral harelip and cleft palate

Fig 8 Case 3 showing contour of lip and nostril 3 months after operation

Fig 9 Case 4 Infant at 10 weeks with complete

unilateral harelip and cleft palate The cleft extends almost into the orbit

Fig 10 Case 4 3 months after operation A second operation will be done at an early date to bring the alar nas into better position

cleft and repairing the harelip as soon as the child is in condition to stand operative procedures This should be done sometime between the eighth day and the third month The remaining portion of the cleft is repaired at the second stage operation which should be performed sometime between the twelfth and twentieth months the time depending upon the child's general health and nutrition

Narrow alveolar clefts in infants with only moderate rotation of the premaxilla may be

closed by firm digital pressure on the premaxilla supplemented by inferomedial pressure against the floor of the nostril and base of septum by means of a small nasal dilator When the alveolar margins are brought into contact they are held in that position by a silver wire suture passed through the upper portion of the alveolar process In older children and in cases in which the alveolar cleft is wide or in which the premaxilla is markedly rotated we usually partially divide the alveolar process on the buccal surface just posterior to the



Fig 11



Fig 12



Fig 13



Fig 14

Fig 11 Case 5 Infant at 4 months with bilateral harelip and cleft palate The entire philtrum was utilized in the repair of the lip each cleft was closed as it would have been if we had been dealing with a case of unilateral harelip

Fig 12 Case 6 Infant 5 months Bilateral harelip and cleft palate of unusual width Marked rotation of premaxilla and philtrum very small

Fig 13 Case 6 14 months after operation

Fig 14 Case 6 one year after operation



Fig. 13



Fig. 17



Fig. 18



Fig. 19

Fig. 13 Sketch shows position of incision for removal of lower portion of vomer and anterior portion of nasal cartilage by submucous resection. A triangular section of bone and cartilage was removed to allow inferoposterior rotation of premaxilla to its normal position. The length of the base of the triangular piece of bone and cartilage removed is determined by the amount of rotation which the premaxilla requires and should be such that when the premaxilla comes into proper position the sides of the triangle will be brought together. There will be a bulging of the mucoperiosteum at this point for several days but the excess tissue soon resorbs.

Fig. 16 Lateral margins of premaxilla and the margins of alveolar process have been trimmed to allow accurate approximation of raw surfaces. Silver wire has been tightened to hold premaxilla in proper position.

Fig. 1 Case Infant age 5 weeks. Complete bilateral harelip and cleft palate. Note elongation of vomer, rotation of premaxilla and shortness of columella. Philtrum is rather well developed.

Fig. 18 Case 1 Three-quarter view of condition mentioned in Figure 17.

Fig. 19 Case 7 age 15 months. Showing contour of lip and no trills 15 months after operation. Note development of columella. Secondary operation will be done to further adjust the lip margins.



Fig. 16

canine area with a thin chisel. Firm pressure on the premaxilla produces a green stick fracture at the site of the partial division and thus allows the alveolar cleft to be closed with the premaxilla in approximately normal position (Fig. 6). The mucous membrane is removed from the margins of the alveolar cleft before the silver wire which holds the margins in apposition is tightened and twisted. Fibrous union is thus secured. If a greater amount of tissue be removed in an infant in an attempt to secure bony union there will probably be an early eruption and loss of a tooth on one or both sides of the cleft. After thus closing the alveolar cleft we repair the cleft in the lip by the same method (Fig. 5) as described in the correction of simple harelip.

In the correction of bilateral harelip the incisions shown in Figure 5 are used if the philtrum is small though we do not remove as much of the tissue from the margins of the philtrum as the artist has indicated in that illustration. When the philtrum is sufficiently large even though the columella be short the entire philtrum is preserved. Incisions are made so that the lateral portions of the philtrum are turned down after which the cleft on each side is repaired independ-

ently. The lateral portions of the lip are usually thicker than the philtrum thus secondary operations to make this inequality less conspicuous may be necessary (Figs. 11, 12 and 17 to 19). When clefts in the lip are quite wide so that in spite of extensive freeing of the alar lips and cheeks from the anterior surfaces of the maxilla there is still tension on the suture line a single shotted stay suture of silkworm gut is applied after the method of G. V. I. Brown. Such a suture produces very little scarring and often less fibrous tissue in the suture lines (Fig. 19).

Complete bilateral clefts of lip and palate often have marked anterosuperior rotation of the premaxilla and elongation of the vomer (Figs. 13, 17 and 18). Such deformities can best be corrected by resecting a triangular section from the inferior portion of the vomer as shown in Figures 13 and 16. The base of the triangle should be just long enough for the rotation of the premaxilla into the position which completes the alveolar arch. If such resection or some similar procedure is not done and the premaxilla is forcibly replaced a degree of deflection of the nasal septum will be produced which will markedly obstruct one or both of the nasal passages.





Fig 7



Fig 8



Fig 9



Fig 10

Fig 7 Case 3 Infant age 5 months with complete unilateral harelip and cleft palate

Fig 8 Case 3 showing contour of lip and nostril 23 months after operation

Fig 9 Case 4 Infant age 10 weeks with complete

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Fig 10 Case 4 3 months after operation A second operation will be done at an early date to bring the alar nasi into better position

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Narrow alveolar clefts in infants with only moderate rotation of the premaxilla may be

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Fig 12 Case 5 14 months after operation

Fig 13 Case 6 Infant age 2 months Bilateral harelip and cleft palate of unusual width. Marked rotation of premaxilla, columella and philtrum very small.

Fig 14 Case 6 one year after operation



Fig 27

Fig 28

Fig 29

Fig 30

Fig 27 Case 10 age 28 years Unilateral barelip bilateral cleft palate Lip had been operated upon when patient was 2 year old and again when 16 years old Note that vermillion border was not properly removed from margins of cleft in lip persisting as a disfiguring red line extending to floor of nostril

Fig 28 Case 10 showing deviation of the nasal septum

flattening of ala nasi and contour of nostril Wide bilateral cleft of palate

Fig 29 Case 10 showing condition 7 weeks after operation on palate 4 weeks after operation on lip

Fig 30 Case 10 showing contour of lip and nostril 5 months after second operation

our own W J Roe in many of his cleft palate operations Cases in which this procedure can be successfully utilized give better length and more firmness to the palate than those in which mucoperiosteal flaps alone are used If the operation is unsuccessful however and the bone flap is lost from necrosis the prospects of a successful secondary operation are much less hopeful than had mucoperiosteal flaps alone been used In 20 per cent of the cases in which we have attempted this method of closure such necrosis did occur but the results obtained in the other cases were so satisfactory that we believe that its use is advisable in carefully selected cases We have utilized Lane flaps only in the secondary closure of persisting openings just posterior to the alveolar margin

In all patients who have had cleft palate operations special training is needed for the correction of the speech defects and whenever the location of the patient's home is such as to make it possible to secure proper instruction it is important that the surgeon urge this need upon the parents of the children or upon the individual in the case of an older patient

The teeth are usually of inferior quality and require special care for their preservation In all cases in which the clefts involve the alveolar process and in many in which the clefts are partial some degree of orthodontic work is required after the eruption of the permanent teeth to effect proper occlusion and to lessen the asymmetry in the dental arch



Fig. 20

Fig. 21

Fig. 22

- Fig. 20 Case 8 Girl age 15 years with complete unilateral harelip  
 Fig. 21 Case 8 showing degree of deviation of septum and flattening of alar nasi  
 Fig. 22 Case 8 age 16 years showing contour of lip and nose 6 months after operation.

In the repair of cleft palates we most frequently use the Langenbeck incisions through which mucoperiosteal flaps are loosened from the rudimentary horizontal portions of the palate and maxillary bones. In cases of wide single unilateral clefts in the palate we have often utilized successfully some of the mucous membrane from the lower portion of the nasal septum increasing to that extent the width of the flap and thus avoiding tension on the suture line.

We have gotten our best results from the use of No. 00 wire sutures in the mucoperiosteal portions of the flaps and black silk sutures in the soft palate. One silk on end mattress suture is used near the junction of the soft and the hard palate to insure broad and exact coaptation of the flaps

at that point. In our experience the use of multiple on end mattress sutures interferes sufficiently with circulation to cause varying degrees of non union in too high a percentage of cases to make their use advisable.

In a small percentage of the cases in our series (approximately 4 per cent) there was sufficient development of the horizontal portion of the rudimentary palate and maxillary bones to make it permissible to attempt bringing a portion of bone over with the flaps (Figs. 23 and 24) a method originally devised by Ferguson used in Philadelphia for many years by J. Ewing Mears and later revised improved and most successfully used by



Fig. 23

Fig. 24

Fig. 23 Case 9 age 17 years. Opening in hard palate persisted after an operation for bilateral cleft palate which was done when patient was 1 year old.

Fig. 24 Case 9. Photograph of palate 2 months after operation.

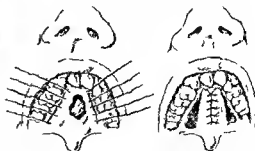


Fig. 25 (left) Semidiagrammatic sketch of Case 9. Dotted line indicates margins of bony cleft. Wire sutures as in case are shown in position.

Fig. 26 Semidiagrammatic sketch of Case 9 showing approximate position of the margins of the opening in the hard palate. The site of the green tick fracture line is indicated as are the posterior ends of the bones in new position.

surface and the whole thickness graft is secured over the entire raw area. Obviously this method cannot be used when the scar margins are thick and rigid.

Years ago one of us brought forward the fact that when a whole thickness graft healed successfully in the midst of an extensive scar either in the gaping wound of a relaxation incision or after a partial excision the tension of the scar was lessened its stability was increased and contracture was more or less relieved. Bearing this in mind and seeking for a method of obtaining greater relaxation from a whole thickness graft we tried out a number of different schemes. Finally we made use of the observation that where one layer of skin overlaps another the tendency of the epithelium during the process of healing is to extend from both epithelial edges to cover the adjacent unepithelialized areas. The utilization of this fact gave the desired result.

#### TECHNIQUE

The method is simple and very easy of application. The contracted portion of the scar is either excised or incisions are made in such a way as to relieve the lines of tension most effectively. Then the entire margin of the defect including the full depth of the scar is undercut as far as necessary usually for a distance of one half centimeter to a centimeter and a half (Fig. 1). Measurements for the whole thickness graft are then taken so that it will be large enough to cover the defect and the undercut area as well. The graft is then cut free of fat and when hemostasis is complete it is sutured in position. This is done in such a manner that the edges of the graft are drawn under the undercut margins to the limit of the recess and are held snug by as many sutures as are necessary. The sutures are inserted at suitable intervals through the scar directly over the outer limit of the undercut area and are then passed through the margin of the graft and returned about one half centimeter from the other limb of the stitch and tied. The result is a margin with an epithelial surface overlying the graft for the distance of the undercut

The wound is dressed with gauze impregnated with 3 per cent zeroform ointment over which a moist sterile sea sponge is placed under pressure and secured by adhesive plaster and a bandage. The dressing is left in place for at least 2 weeks unless in a situation where frequent change is indicated. At the end of that time the sponge is removed and the sutures taken out. The subsequent treatment is that of any grafted area.

#### COMMENTS

The method is simple and most effective in situations where the scar tissue is too rigid to shift and where pedunculated flaps cannot be used. It is particularly satisfactory when dealing with extensive scars but we have used it successfully in filling defects in normal skin.

The graft itself is immobilized and any desired tension may be secured. Its edges are protected from infection which is an item of importance in certain areas such as around the mouth. By using the whole thickness graft in this manner a larger graft can be used and the maximum ultimate relaxation can be gained for a given size of graft.

In the process of healing epithelium from the edges of the graft and from the edges of the scar defect grow toward each other and finally meet thus covering the under surface of the undercut margin. This temporarily results in an overlapping everted margin surrounding the graft both sides of which are epithelialized. At first this is somewhat unsightly but in the course of a month or two aided by massage and scar tension this margin flattens out and becomes smooth. Thus one gains a considerable distance beyond the edge of the grafted area and in consequence more relaxation (Fig. 2).

At first we used molded dental compound for holding the graft flat under the undermined edges but soon found that it was unnecessary. Fewer sutures are required to secure the graft properly than when the usual technique is followed.

We have used this procedure for some time for the relief of scar contractures in various situations and have found it very satisfactory.

# A METHOD OF OBTAINING GREATER RELAXATION WITH WHOLE THICKNESS SKIN GRAFTS<sup>1</sup>

By JOHN STACEY DAVIS M.D. BALTIMORE  
AND

HERBERT F. TRAUT M.D. BALTIMORE  
Rock Hill & F.H. = Plastic Surgery

WHEN a considerable area of scar tissue has replaced the full thickness of the skin and sometimes also the underlying tissues contraction usually follows. This contraction varies according to the size of the surface involved and the depth of the scar. The statement is frequently made that in the relief of scar contractions in plastic surgery the scar tissue should always be completely excised before reconstructive work is done and this is a good working rule in certain types of scar and in certain situations. However when the scar is so extensive that complete removal is impossible even by gradual partial excision we have to resort to one means or another to relieve the contraction. Among the methods employed may be mentioned the lengthening of the contracted bands by Z shaped incisions and closure after shifting the flaps thus made excision of the binding portion with the insertion of pedunculated flaps from neighboring tissues or from distant parts ex-

cision of or relaxation by division of the binding portion of the scar followed by skin grafting of the defect thus made.

In some instances the scar is so extensive that the neighboring tissues cannot be utilized for pedunculated flaps. In others it is not advisable to make more scar than is already present. In still others the unsightliness of the Italian method must be avoided. These cases must then be treated in either one of two ways by the shifting of scar flaps if they are not too rigid or by the implantation of skin grafts after the tension bands have been either excised or relieved by division.

There is no doubt that whole thickness grafts are more satisfactory for this purpose than either Ollier Thiersch or small deep grafts and in consequence this type of graft should be used.

Blair has evolved a useful method of increasing the raw surface after complete excision of a scar in order to use a larger whole thickness graft. He undermines the skin edges and turns them outward so that the raw surface is increased by almost twice the area of the undermining. He passes sutures in such a way that the undermined margins are turned skin surface to skin

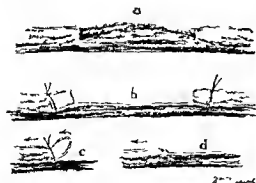


Fig. 1. a Schematic drawing showing a defect made by the removal of the binding portion of an extensive scar. The dotted lines indicate the incisions made to underturn the scar edges all around the defect. b Shows the edges undercut and raised. The whole thickness graft is drawn as a flap back under the undermined area as possible and is held in position by sutures. Indicates the junction of the epithelium from the scar margin and the margin of the graft. The upturn of the margin from what was exposed. d Indicates the gradual flattening of the edges which finally become level or almost level with the surrounding scar.



Fig. 2. a Shows a whole thickness graft implanted in the cheek for the relief of an extensive contracted thickened scar. Note the graft drawn under the undermined scar edges. Photograph taken 2 weeks after implantation. b The same graft about 1 year later. Note the excellent condition of the graft, the amount of relaxation obtained and the smoothness of the edges.

surface and the whole thickness graft is secured over the entire raw area. Obviously this method cannot be used when the scar margins are thick and rigid.

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HERBERT F. TRAUT, M.D., BALTIMORE

Rock Hill, S. C., Fall 1911, The J. T. C. Surgery

WHEN a considerable area of scar tissue has replaced the full thickness of the skin and sometimes also the underlying tissues contracture usually follows. This contracture varies according to the size of the surface involved and the depth of the scar. The statement is frequently made that in the relief of scar contractures in plastic surgery the scar tissue should always be completely excised before reconstructive work is done and this is a good working rule in certain types of scar and in certain situations. However when the scar is so extensive that complete removal is impossible even by gradual partial excision we have to resort to one means or another to relieve the contracture. Among the methods employed may be mentioned the lengthening of the contracted bands by Z shaped incisions and closure after shifting the flaps thus made; excision of the binding portion with the insertion of pedunculated flaps from neighboring tissues or from distant parts; ex-

cision of or relaxation by division of the binding portion of the scar followed by skin grafting of the defect thus made.

In some instances the scar is so extensive that the neighboring tissues cannot be utilized for pedunculated flaps. In others it is not advisable to make more scar than is already present. In still others the irksomeness of the Italian method must be avoided. These cases must then be treated in either one of two ways: by the shifting of ear flaps if they are not too rigid or by the implantation of skin grafts after the tension bands have been either excised or relieved by division.

There is no doubt that whole thickness grafts are more satisfactory for this purpose than either Other Thierch or small deep grafts and in consequence this type of graft should be used.

Blair has evolved a useful method of increasing the raw surface after complete excision of a scar in order to use a larger whole thickness graft. He undermines the skin edges and turns them outward so that the raw surface is increased by almost twice the area of the undermining. He passes sutures in such a way that the undermined margins are turned skin surface to skin

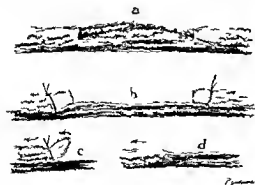


FIG. 1. a Schematic drawing showing a defect made by the removal of the binding portion of an extensive scar. The dotted lines indicate the incision made to undercut the scar edges all around the defect. b Shows the edges undercut and raised. The whole thickness graft is drawn as far back under the undermined area as possible and is held in position by sutures. c Indicates the junction of the epiderm from the scar margin and the margin of the graft. The suture of the margin is somewhat exaggerated to indicate the gradual flattening of the edges which finally become level or almost level with the surrounding scar.



FIG. 2. a Shows a whole thickness graft implanted on the back to the relief of an extensive contracted thickened scar. Note the graft drawn under the undermined scar edge. b Photograph taken one year later. Note the excellent condition of the graft, the amount of relaxation obtained and the smoothness of the edges.

pable of a wide application in the treatment of lesions occurring in the abdomen neck and elsewhere in the body

For example in intra abdominal malignancy with glandular metastases it will be easy to insert the needle carrying a high frequency current and almost literally explode diseased glands out of existence leaving the dead tissue to be absorbed *in situ*. This method of actually removing diseased lymphatic glands without long and ted-

ious dissection with consequent danger to the patient is a tremendous adjunct to our surgical technique

**NOTE**—This work was done independently and without knowledge of the work of Corbus and O'Connor  
CORBUS R. C. A case of prostatic carcinoma of the prostate treated by diathermy and radium. *Am J Clin Med* 1921 April

CORBUS R. C. and O'CONNOR A. J. Diathermy in the Treatment of Genito Urinary Diseases with Especial Reference to Cancer. Bruce Publishing Co. 1935

## EFFICIENT SUPRAPUBIC SUCTION DRAINAGE

By HAROLD H. GILE, M.D., BOSTON

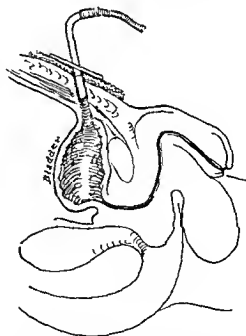
From the U. S. Army Medical Department, Boston, Massachusetts

**S**UCTION drainage has of late years become an increasingly important factor in many phases of surgery. It would seem to be especially adapted to operations upon the urinary bladder and yet there has been relatively little use made of it in this field.

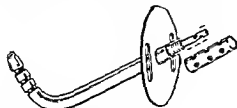
For many years various forms of suction have been tried in an effort to keep prostatic patients dry after suprapubic operations but apparently none have met with general approval. In fact the idea of using suction following suprapubic cystotomy has been in disfavor among the majority of genito-urinary surgeons. Their reasons against its being used are (1) that it may cause bleeding (2) that it requires too much attention (3) that they have never seen it work satisfactorily (4) that most suprapubic wounds heal all right anyway if left alone regardless of urinary drainage.

None of the above arguments or any other which I have heard seems sufficient to discountenance the use of suction drainage in these conditions if it can be successfully and easily accomplished.

Without any doubt the most disagreeable feature in the postoperative course of patients who have undergone operations upon the bladder is the drainage of urine which keeps them wet until the tract has healed. Not only is this condition unpleasant for the patient but also time consuming for the nurses who must care



**Fig. 2** Sagittal section showing suction apparatus in position. There is a flat piece of gauze between the flange of sucker and the skin. Note that position of this device in no way interfere with closure of bladder wound.



**Fig. 1** Shows suction device drawn actual size. The flattened protection collar is unscrewed from tip of sucker. The material of which the apparatus is made is aluminum.



# THE TREATMENT OF CARCINOMA OF THE PENIS WITH ENDOTHERMY WITH A METHOD OF TREATMENT OF METASTATIC MALIGNANT LYMPH GLANDS

## REPORT OF A CASE

By HOWARD A. KELLY, M.D., F.A.C.S. and GRANT E. WARD, M.D., BALTIMORE, MARYLAND  
From the Howard A. Kelly Hospital, Baltimore, Md.

**C**ARCINOMA of the penis in our experience seems to be a fairly common disease. It should be suspected by the general practitioner in every puzzling lesion of the penis he may see. Of the several methods of treatment—surgery, radium, X-ray and endothermy (surgical diathermy) in most instances we prefer the latter and herewith briefly report a case.

Mr. C. H., age 65, entered the hospital on June 30, 1924, complaining of a sore on the penis. The family and past histories are unessential. The present illness began 2 years previously at which time the patient suffered with an open sore following an accident in which the penis had been injured. Examination revealed a vegetative growth on the left side of the organ just above the glands measuring 3 by 2.5 centimeters and 4 to 5 millimeters in elevation. The edges were rolled over and sharp. A large gland about 3 centimeters in diameter was found in the left groin but none in the right. The abdomen was negative except for a post-operative hernia in an old appendix scar. General physical examination showed patient to be in good condition.

**Operation.** Under a general anesthetic, nitrous oxide and ether the local growth was thoroughly treated with bipolar endothermy (electrocoagulation—Clark) and excised. The skin overlying the large gland in the left

groin was incised with the endotherm knife (sector) and the gland punctured and coagulated with a strong bipolar current. A piece of tissue was taken for diagnosis and the gland left in situ to be absorbed. The skin was closed over the coagulated gland with black silk suture and dry dressings applied.

**Postoperative course and treatment.** The patient made an uneventful recovery save for a little gaping of the skin edges of the groin incision and a serous discharge. The area on the penis was dressed daily with balsam of Peru ointment. Before leaving the hospital the left groin was given a heavy outside distance radiation with radium. No radium or X-ray treatment was given the local lesion. He left the hospital a few days after the operation and has returned from time to time for examination during the past year with no sign of recurrence. Both the scars are soft and pliable. The accompanying photograph was taken 11 months after operation.

## DEDUCTIONS

1. With proper technique (coagulation) the local lesion in carcinoma of the penis can be cured with endothermy.

2. It is possible to eliminate a metastatic gland by incising the skin and exposing it and treating it with the strong bipolar coagulating current destroying the whole interior of the gland. This is an exceedingly important principle.

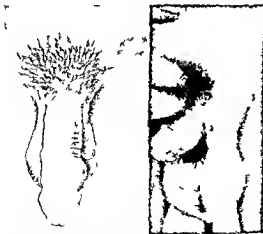


Fig. 1. Drawing of primary carcinoma of glands penis with enlarged gland in left groin before treatment.

Fig. 3. Photograph 11 months after treatment. The penial scar is soft and pliable; no induration in the groin.



Fig. 2. Photomicrograph of tissue removed from the inguinal gland after coagulation with a strong bipolar current. Note the coagulation of the tumor cells into a mass of homogeneous material.

TABLE I—LONG SUCKER USED

| Case Number | Type of type of phly | Length of sucker | Days of use | Days dry post op |
|-------------|----------------------|------------------|-------------|------------------|
| 22764       | General              | No               | 2nd-7th     | 12th             |
| 22704       | General              | No               | 3rd-9th     | 10th             |
| 23500       | General              | No               | 3rd-8th     | 13th             |
| 23113       | Median               | No               | 2nd-7th     | 8th              |
| 23562       | General              | Yes              | 2nd-7th     | 10th             |

TABLE II—SHORT SUCKER USED

| Case  | Type of type of phly | Length of sucker | Days of use | Days dry post op |
|-------|----------------------|------------------|-------------|------------------|
| 24120 | General              | No               | 1st-13th    | 13th             |
| 24209 | General              | No               | 1st-10th    | 13th             |
| 24175 | General              | No               | 1st-9th     | 15th             |
| 24438 | General              | No               | 1st-13th    | 16th             |
| 24449 | Median               | No               | 1st-10th    | 11th             |
| 2494  | General              | No               | 1st-8th     | 10th             |

obtained from the water faucet though motor power as obtained with the Connell eithrizing apparatus would be as satisfactory (Fig. 1).

At first a long shaft on the sucker was employed so that it might take a position within the bladder cavity. This arrangement functioned perfectly well, but had the same objection as the mushroom catheter in that it maintained an opening into the bladder. After 7 or 8 days the sucker was removed and the patient was placed on continuous urethral drainage. This program was effectual in that it kept the patient dry at all time and with it the operative wounds remained perfectly clean. However the method did necessitate a catheter in the urethra for several days which is certainly not to be desired.

Later I could see no advantage in having the sucker extended into the bladder cavity. In fact it seemed more in accord with good surgical principles that the superficial portion of a drained wound should be kept open until the deeper parts had closed. Consequently I had a short sucker made which penetrated not more than 3 centimeters below the skin surface. This has worked ideally on the few cases already tried. This method allows the bladder wall to close completely while the suction continues to keep the patient dry. The result is that the bladder wound heals more quickly and urethral drainage is entirely unnecessary. It is also fortunate that this apparatus works as efficiently with the patient sitting in a chair as it does with the patient lying in bed. Also it is quite simple to detach the rubber tube from the suction device leaving the latter in place to allow

the patient to take short walks reconnecting the tube and sucker on returning to the bed or the chair (Fig. 2).

Convincing proofs of the efficiency of this procedure are (1) the patient's satisfaction (2) the nurses' enthusiasm about it as compared with former methods, (3) the rapid convalescence and attainment of the dry condition (4) the absence of an infected wound in any case so far (5) the ability to make an accurate collection of the urinary output.

This suction arrangement has been used on the following cases. On the first group the long sucker was used (Table I). All these were one stage prostatectomies.

On the next group the short sucker was used (Table II). The first five were one stage operations, the last was a two stage type.

The short sucker has proved very much superior to the long one and is now used exclusively. No case yet has become wet again after once becoming dry. There has been no instance of hemorrhage being caused. Indeed this is hardly a possibility when one considers that the suction device does not extend even to the bladder itself. In none of these cases has the urethral catheter been necessary.

### CONCLUSIONS

The advantages to be gained from the use of efficient suprapubic suction drainage are:

1. The patient is dry after first 4 hours following operation.
2. It eliminates frequent dressings.
3. The wound is kept free of urinary drainage and postoperative wound and bladder infection is apparently reduced.
4. It allows early closure of the vesical wound.
5. It requires a minimum amount of attention.
6. Complete healing occurs earlier.
7. The patient's stay in the hospital is materially shortened.

### REFERENCES

1. HEAVEN, C. Note on the drainage of large cavities after surgical operations. *Brit. M. J.* 1898 Jan. 22, 207-208.
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3. CRETWOOD, C. H. Drainage of the bladder following suprapubic operation. *Med. Rec.* 1914 lxxv 602.
4. DAVIS, E. G. Vesical drainage. *J. Am. M. Ass.* 1910 May 27 p. 1630.
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for him. For this reason the prostatic is never a popular admission with the nurses or house staff of any hospital. Quantities of gauze dressings and the almost constant attention of a special nurse are essential to keep such a patient even partially dry. Furthermore despite the fact that most suprapubic wounds do eventually heal even though but little care is taken of them, it is far from ideal to have a constant flow of urine over a wound which we are attempting to heal. This is especially undesirable during the first postoperative days when the wound is recent and more liable to infection, for in the majority of cases of prostatic obstruction the urine is already infected before operation.

In an effort to obviate this postoperative wetness several schemes have been followed:

1. Special types of dressing have been devised such as one in which the sinus tract is surrounded with a circle of heavy ointment over which is placed an oil silk or rubber dressing with an opening in it which is superimposed over the sinus tract and surrounding ointment. This waterproof material contains gauze and is folded in such a way that if the dressing does not slip the urine enters the interior of this contrivance and is absorbed by the contained gauze. At best this can be used successfully only by a nurse who can give an undue amount of her time to it.

2. After removal of the suprapubic tube left at operation increasingly smaller sized tubes have been substituted as time goes on. A certain amount of urine may drain this way but there is nearly always some leakage.

3. Mushroom catheters have been substituted for the suprapubic tube after its removal. These are efficient in draining the larger part of the urine but there is usually some leakage and furthermore the retention of this mushroom catheter necessitates the continuance of an opening in the bladder wall.

4. After the fourth or fifth postoperative day some surgeons make a practice of placing the patient on constant urethral drainage. This undoubtedly hastens the closure of the suprapubic wound by diverting the urinary stream but it does not keep the patient entirely dry and does not solve the problem of wetness for the first few days when the wound is most recent and most likely to become infected from the contaminated urine. It is also doubtful whether it is wise to place a foreign body such as a catheter in such intimate contact with a prostatic bed not yet healed. Again the very real danger of a purulent urethritis and the possibility of epididymitis must be considered if this method be employed.

5. Many different forms of suction apparatus have been devised and reported but none has enjoyed general use.

a. G. Heaton in 1898 made use of a siphon arrangement which had been employed by dentists in England at that time. He pointed out the necessity of having an outer fenestrated portion around any suction tube to protect the tissue from being drawn up by the vacuum.

b. Kenyon and Poole in 1913 described similar suction tubes used by them in aspiration of many types of wounds. They obtained power from the water suction pump.

c. Chetwood in 1914 obtained good results with an arrangement entirely like the one we are now using except for the suction tube itself. He used a small rubber tube inside a larger fenestrated one. In addition he employed a needle valve between the vacuum pump and the bottle to reduce suction. He describes one case in which hemorrhage was started from excessive suction. He left the tube in the bladder for 10 days after which he removed it and collected the urine from then on in a bell shaped glass cover stripped over the sinus.

d. Davis in 1916 used a vacuum bottle arrangement.

e. Bethune in 1918 brought out an apparatus consisting of two opposed 2 gallon carboys. Suction is caused by the water in one bottle dripping through connecting glass tubes to the opposite bottle. When the top bottle is empty the frame is turned so that the full bottle is again on top and the process continues. With this he uses a small catheter inserted into the bladder which is removed when the sinus tract has closed sufficiently to hug the catheter tightly. This apparatus met with considerable favor and has been used to some extent in many hospitals. The objections to it are that it is not uncomplicated, that it does not have sufficient power and that it is difficult to find an interne or nurse who is enough interested to spend the necessary time and effort to keep it functioning.

Feeling that suction drainage had never been given a fair trial in the solution of this problem I devised a small instrument consisting of a suction tube with a whistle tip outside of which is a perforated guard which prevents any surrounding tissue from being drawn in to clog the suction opening. The suction end fits into the sinus tract and the other end fits into a rubber tube which takes the urine into a bottle beside the patient's bed. There is a flange offset from the horizontal in such a way as to fit the typical obliquely directed sinus tract. The power for the suction is

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| 22 04       | General             | No         | 3rd-9th   | 19th           |
| 23,60       | General             | No         | 3rd-8th   | 13th           |
| 23113       | Median              | No         | nd-7th    | 8th            |
| 23 62       | General             | Yes        | 2nd-8th   | 10th           |

TABLE II—SHORT SUCKER USED

| Case number | Type of type tr phy | U th l sed | Day to sed | Day d post f t |
|-------------|---------------------|------------|------------|----------------|
| 24120       | General             | No         | 1st-13th   | 15th           |
| 4 06        | General             | No         | 1st-10th   | 13th           |
| 24175       | General             | No         | 1st-9th    | 15th           |
| 24438       | General             | No         | 1st-13th   | 16th           |
| 24749       | Median              | No         | 1st-10th   | 11th           |
| 240,5       | General             | No         | 1st-8th    | 10th           |

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#### CONCLUSIONS

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- 1 The patient is dry after first 24 hours following operation.
- 2 It eliminates frequent dressings.
- 3 The wound is kept free of urinary drainage and postoperative wound and bladder infection is apparently reduced.
- 4 It allows early closure of the vesical wound.
- 5 It requires a minimum amount of attention.
- 6 Complete healing occurs earlier.
- 7 The patient's stay in the hospital is materially shortened.

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# A METHOD OF PASSING A WAX TIPPED CATHETER THROUGH THE CYSTOSCOPE WITHOUT MAKING A SCRATCH

BY R. S. MAJARD, M.D., FORT WORTH, TEXAS

**K**NOWING the difficulty sometimes in differentiating a scratch made by an instrument from one caused by a stone on a wax tipped catheter I have attempted to obviate this difficulty by passing the wax tipped catheter through the cystoscope protecting the tip of the catheter by the finger tip of a rubber glove. I do not know whether or not this method has been used before. If it has I would appreciate some one sending me the reference. The method is very simple and practical. I have tried it with the cystoscope inside and outside of the bladder and after passing the experimental stage have not had any difficulty.

The cystoscope is introduced in the usual way and the obturator is removed. The wax tipped catheter is covered by a finger tip cut from a new rubber glove. The finger tip is attached to a coarse type of sewing thread, the thread transfixing the apex of the finger tip and tied in a large loop passed through its most convex portion. When the finger tip is in place over the waxed end of the catheter the catheter is gently pushed through the cystoscopic sheath well into the bladder. No attempt is made to fasten the finger tip to the catheter. A little difficulty is encountered in getting the end of the catheter through the fenestra of the sheath but a little gentle manipulation will overcome this. After the catheter is inserted well into the bladder the finger tip will fall off or will be washed off by the flowing stream of water and will float about attached to the thread. By means of this thread the shield can be immediately withdrawn from the bladder through the cystoscopic sheath. This



Fig. 1. Cystoscope showing rubber glove finger tip attached to thread.

should be done very gently as the thread is likely to cut through the rubber and leave the finger tip in the bladder. Traction on the thread should be gentle and steady. If the finger tip should become detached the mishap should not be a serious one if one has a cystoscopic forceps at hand.

In experimenting with this method I passed a wax tipped catheter through the sheath of a Brown Buerger cystoscope twenty one times consecutively and through a McCarthy cystoscope twelve times without making a scratch. I probably could have passed it many more times with the same result. During these thirty three trials the finger tip pulled off the thread once and this could have been avoided by using less traction and a little more time.

The advantage of this method is that it eliminates the pain, difficulty and trauma of passing the cystoscope through the urethra over a wax tipped catheter as described by Goldstein of Baltimore.

## EDITORIALS

### SURGERY, GYNECOLOGY AND OBSTETRICS

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MAY 1926

#### CHRONIC APPENDICITIS

ANY member of the medical profession questions the existence of chronic appendicitis which has not had its origin in acute appendicitis. However, chronic appendicitis may exist without clinical evidence or previous history of an acute attack. There are at least two well defined types of chronic appendicitis.

In the first type the appendix contains fecal concretions often of considerable size and sometimes to the touch like a string of beads. Occasionally one sees a case of unexplained hemorrhage from the stomach in which finally an exploratory operation reveals no other cause than such an appendix. Following removal of the appendix the patient has no more hemorrhages, gains greatly in weight and apparently gets well. One may assume that this recovery is a coincidence and not a consequence of the appendectomy, but certain careful observers believe that a chronic infection which is carried to the liver from the appendix is responsible for the hemorrhagic erosions of the mucous membrane of the stomach which are sometimes found in these cases. The French

have written interesting contributions on this condition.

In the second type, one explores for a perplexing epigastric condition, does not find lesions in the upper abdomen but brings to light a markedly diseased appendix buried in a mat of adhesions, when there has been nothing in the clinical history to indicate that the patient ever had an acute attack of appendicitis. An appendix of this type is often seen in conjunction with cholecystitis without stones. Moynihan suggests that possibly such an appendix may be related etiologically to duodenal ulcer. These two varieties of appendicitis, unless there is retention of secretions or local peritonitis, do not give rise to pain in the right iliac fossa but painful sensations are referred to the epigastric region and are recognized clinically in a considerable group of cases as appendiceal dyspepsia from the associated pyloric spasm.

The reticulo-endothelial tissues represented among other organs by the spleen, the lymph nodes and the tonsils reach their height of development during the adolescent period and from then on undergo gradual loss of function. So true is this that in a very high percentage of the spleens of persons in middle and later life the pulp cells have disappeared to a large extent and have been replaced by fibrous tissue. Thirty years ago, it was pointed out by Charles H. Mayo that the progressive age atrophy of the lymphatic tissues of the body undoubtedly accounted for the relatively slower progress of cancer in the old than in the young because of the greatly lessened amount and activity of the lymphatic tissues. Often a young person has

very large tonsils, which later in life become so reduced in size that they can scarcely be identified

The appendix contains lymphoid tissue of the same general character as that in the tonsils and undergoes the same trophic changes. Ribbert demonstrated the incidence of involution in the appendix and asserted that in persons under 25 years of age 25 per cent of appendices show the changes of involution. Between the ages of 25 and 50 50 per cent of persons show these changes and between the ages of 50 and 75 nearly 75 per cent show chronic involution. These changes begin in the tip of the appendix and extend to the base. Much friable fat is often present in the meso-appendix. The process when complete was at one time called appendicitis obliterans. An appendix of this character cannot be considered pathological.

The autonomic nervous system of Langley formed by Gaskell's nerves from the anterior horns of the spinal cord to the great sympathetic ganglia with the vagus and the pelvic nerve forms the great thoracic and abdominal nerve plexuses and gives the appendix its nerve supply. We have learned only recently that these nerve fibers are also nerves of sensation. In chronic disease conditions of the appendix distressing sensations being referred to the epigastric region there being no pain or tenderness on palpation of the right iliac fossa with which region there are no direct nerve connections.

Mistakes in diagnosis are made because of overemphasis of the possibility that pressure on a chronically diseased appendix without localized peritonitis and retained secretions causes pain at the so-called McBurney's point.

The neurasthenic patient whose attention has been focused on the right iliac fossa region which has been subjected to repeated

sometimes rather painful manipulations to elicit tenderness is operated on for the removal of an appendix undergoing normal involution and the operation, the failing to give the relief expected by the patient unless from suggestion, is humiliating and disappointing to the surgeon.

The misinterpretation of the changes in the appendix as a result of involution which have been mis-called chronic appendicitis has probably led to most of the difficulty in case of what has flippantly been called 'right siditis'.

W J Mayo

### ACUTE OSTOMYELITIS

IT is the common experience of clinicians in all large clinics both for adults and children to find that very rarely is the diagnosis of acute appendicitis overlooked. With a correct diagnosis efficient treatment is instituted early. As a consequence almost in one generation the mortality from this condition has been reduced to a minimum, the suffering enormously diminished and the economic loss from a long and wasting convalescence correspondingly lessened. The general practitioners in all sections are wide awake to the signs and symptoms of this condition and the necessity of an early diagnosis.

On the other hand it is an equally common experience especially in the large children's clinics to find that an early diagnosis of acute osteomyelitis is rarely made and in every such clinic are found large numbers of cases with extensive and destructive inflammations of bone which must result in long and tedious courses of treatment with the probability of recurring attacks of infection over a period of many years if not throughout a whole lifetime. It is with the hope of stimulating a new interest in this important subject that the writer takes advantage of this opportunity to place before the readers

of SURGERY GYNECOLOGY AND OBSTETRICS, some facts gleaned from a fairly large experience

A correct diagnosis of osteomyelitis is not difficult in the vast majority of cases if practitioners and consultants are alert to the possibilities of its occurrence. The history of the case is most important. The disease is pre-eminently a disease of childhood and rarely occurs after the epiphyses are completely fused with the shaft of the bone. The infection is blood borne and is either staphylococci or streptococci in type, the staphylococci infection being the more common and in this instance the more virulent. The source of the primary infection in the case of the streptococcus is the mouth cavity including the tonsils and sinuses or middle ear while in the case of the staphylococcus it usually arises from the skin surface as a boil or infected abrasion. An infected abrasion of the heel is very common. The history carefully worked up shows that a child apparently perfectly well develops a sore throat or has a local skin infection and possibly receives some injury which may be sufficient to wrench or twist one of the epiphyses. It is capable of demonstration that such traumatism may cause minute hemorrhages in the region of the metaphysis making a good culture medium for organisms and at the same time lowering the resistance of this part to any infection. A few days subsequently pain and tenderness develop in the neighborhood of a joint and this is accompanied by signs of general infection namely fever often to 103 or 104 degrees F rapid pulse dry tongue and a definite leucocytosis.

A careful and patient examination is the next essential. It will be noted that at this early stage no signs of joint change are found. That is there is no fluid in the joint no swelling of any kind and by careful examination

passive movements of the joint may be elicited freely and without pain. This should exclude septic arthritis and acute rheumatic fever with joint manifestations. It is also possible of demonstration that the pain is adjacent to the joint but not in it. The tenderness will be marked about the epiphyseal level and usually more definite on one side than on the other. This gives the best clue to the point of incision for early treatment. In the case of infection of the upper end of the femur where the upper epiphysis lies within the capsule of the joint, the osteomyelitis will almost always be accompanied by a septic arthritis of this joint as well and probably all cases of acute epiphysitis in the upper end of the femur in infants are primarily cases of acute osteomyelitis. The X-ray findings are always negative in this early stage.

The diagnosis being thus early established prompt treatment should result in clearing up the infection without sequestration or fear of subsequent recurrence. A word as to the pathology will aid in the determination of the correct line of treatment. Early autopsy investigation of cases dying of acute general septicæmia with local osteomyelitis a careful study of X-ray findings and experimental studies in animals have clearly established the fact that the infection is carried to the minute capillaries in the diaphyseal end of a long bone from a local focus and that it spreads from that point. It has also been demonstrated that contrary to earlier teaching the infection spreads most readily along the epiphyseal line to the cortex. If it is remembered that the cortex at the epiphysis is so thin as to be scarcely recognized as compact bone it is easy to understand that no barrier is met here to prevent spread to the periosteum. The periosteum being closely attached to the epiphysis beyond the



epiphyseal line prevents the spread of infection to the joint, the stripping of this membrane from the shaft is away from the joint.

If this pathological picture is correct then the obvious treatment as soon as the case is diagnosed is adequately to drain the infected area of bone and thus prevent the spread of the infection and prevent also the wide spread stripping of the periosteum from the shaft. Over the point of maximum tenderness and on the diaphyseal side of the epiphyseal line an incision should be made through the periosteum to the bone. If no frank pus is encountered and only some œdema of the soft tissues found the periosteum may be stripped for a short distance with a blunt periosteal elevator. Then a small window may be cut out of the cortex or a series of two or three drill holes made obliquely into the cancellous bone toward

but not reaching the epiphyseal line. Culture of the bone dust removed will show infective organisms even if no free pus is discovered. In the course of 24 hours frank pus is usually present coming from the drainage tube.

No further operative interference is called for or is even justified in this early stage and least of all is it wise to open the medullary cavity either by trephine or chisel. The desired result in this early stage is to drain an infected area of bone before the blood supply is cut off by inflammatory blocking of the blood vessels and thus head off necrosis and sequestration of bone. This has been accomplished in a gradually increasing number of cases and can be still further extended with the co operation of a greater number of interested practitioners.

CLARENCE I. STARR





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CLARENCE L. STARR





A H FERGUSON  
1853-1911

# MASTER SURGEONS OF AMERICA

## ALEXANDER HUGH FERGUSON

ONE of those who reached the highest rank among American surgeons was the late Alexander Hugh Ferguson of Chicago. A Canadian by birth of Scottish parentage and a direct descendant of a line of Covenanters he gradually rose from the obscurity of a rural home to become one of the outstanding figures among the surgeons of America.

He was born near the village of Woodville in the Province of Ontario on the 27th of February 1833. Of strong vitality and a clear mind, he possessed the rare qualities of persistency, perseverance and a great capacity for work which eventually overcame all obstacles and carried him to great achievements. His education was of that practical quality of the Ontario Rural Schools which served him so well in after life himself becoming a teacher and later a tutor of Latin at the Rockwood Academy. The lure of the West attracted his parents to Manitoba and they settled in Winnipeg where he studied at the Manitoba Presbyterian College. He continued his studies at Toronto University and Trinity Medical School where he graduated a Bachelor of Medicine in 1881, and the same year an Honorary Graduate M.D., C.M. later taking advanced training in New York, Glasgow, London and Berlin. From the University of Berlin he attained a special certificate in bacteriology.

Returning to Winnipeg he began the practice of his profession in 1882. In 1883 he with twelve others outstanding men even in those early days of the country's development founded the Manitoba Medical College which has since become affiliated with the University of Manitoba one of the leading universities of Canada. Associated with Dr. Ferguson in founding the Manitoba Medical College and justly entitled to the distinction of being the pioneers in medical education in Western Canada were Doctors James Kerr (deceased), James Robert Jones (deceased), Robert Johnston Blanchard, Winnipeg, Robert George Brett, Edmonton, Robert Buchanan Ferguson (deceased), James Wilford Good, Vancouver, James William Whiteford (deceased), James Patterson (deceased), Theogene Fafard (deceased), Andrew McDiarmid, Pocatonton, Hon. David Henry Wilson (deceased), William Robert Douglas Sutherland (deceased). These men possessed a wonderful vision and some of them lived to see the realization of their dreams in bricks and mortar a Grade A medical school.





Chicago Gynecological Society, Chicago Surgical Society, Fellow American Surgical Association, Chicago Academy of Medicine, American Association of Gynecologists and Obstetricians, Southern Surgical and Gynecological Association, Western Surgical and Gynecological Association (ex president)

Among an ever increasing circle of friends and admirers Dr Ferguson's loyalty and devotion to those of his early days never waned. He possessed in a large measure that quality which is known by the Scots as "clannish." His door, 4619 Grand Boulevard, was ever open to his old friends especially those from Canada. He was a member of the Scottish Rite a thirty second degree Mason (A F & A M) and a member of the Presbyterian Church.

After a brief illness he passed away on October 6, 1911, being survived by Mrs Ferguson who is a daughter of the late Mr Edward Thomas Esq. of Nassagawaya, Ontario, and two sons, Mr Ivan Havelock Ferguson and Alexander Donald Ferguson, M.D. of Chicago.

Dr Ferguson contributed his quota to the advancement of the science of surgery. As a leader in the surgical thought of his day he ranked with Fenger, Senn and Murphy. His was a life worthy of emulation. NEIL JOHN MACLEAN

In 1886, Dr Ferguson accepted the professorship of surgery in the Manitoba Medical College following the late James Kerr who resigned to accept a similar chair in Columbia University Washington District of Columbia. He was a member of the staffs of the Winnipeg General and St Boniface hospitals. On December 18 1893 the chair of surgery in the Post Graduate Medical School and Hospital of Chicago was offered him which after due consideration he accepted and assumed his duties in June 1894.

The esteem in which he was held by his professional brethren in Canada is reflected in an illuminated address presented by the Faculty of the Manitoba Medical College upon his departure.

'As Professor of Surgery you have not only commanded the admiration and regard of your Associate Professors but also the veneration and loyal esteem of your students. Your operative work in Hospital and Private practice has challenged the keenest attention of the Medical Profession of this country and has reflected the highest honor on yourself and credit upon the Medical Profession of Canada etc.'

In time he became owner and chief surgeon of the Chicago Hospital one of the most efficiently equipped institutions in the West at that time. In 1900 Dr Ferguson accepted the chair of professor of clinical surgery in the College of Physicians and Surgeons (University of Illinois College of Medicine) one of the most progressive colleges in America.

Dr Ferguson's fame as a teacher of surgery and as a skilful operator extended beyond the shores of America and some years before his death King Carlos of Portugal honored him with a decoration of which he was justly proud. The Commander of the Order of Christ for 'excelling in surgery. Being diligent he did stand before kings.'

Intuitively he seemed to possess the power to apply means to ends. Thus he devised many surgical instruments that bear his name the Ferguson artery forceps Ferguson pedicle clamp a prostatic retractor for the operation of perineal prostatectomy and other instruments. He developed and improved the operation for cleft palate excision of the maxilla for malignant disease and devised an ingenious operation for drainage of the subarachnoid space into the peritoneal cavity by tunnelling through the body of the fifth lumbar vertebra and inserting a silver wire seton. Although not a voluminous writer he contributed a number of excellent articles on surgical topics and wrote a monograph on hernia which is a classic on this subject. The operation for inguinal hernia with which his name is associated is at many clinics the most popular today.

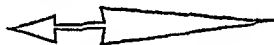
Dr Ferguson was a member of the following medical societies and was one of the outstanding figures at their gatherings. The British Medical Association the American Medical Association International Surgical Congress Chicago Medical Society (ex president 1910) Michigan State Medical Association (Hon.)



& cum instrumento separetur cranium undique circa plicaturam,



& cum terebello perforetur,



& totum cranium remoueat Reliqua de fractura cranei prædiximus.

*De hinc cum euulsione capillorum curabilium & incurabilium,*  
Caput XXVI

**T**inearum alia curabilis, alia incurabilis Incurabilis his signis cognoscitur, cutis est densa & dura, squamas multas emittit, pilos corrodit, huius curam relinquimus Eius uero quæ est curabilis duæ sunt medicinæ Vna pilos multos educit, & quosdam ualde grossos, & cutis est grossa tum continua non dura Altera, non habet grossam cutem & scissam, non multo pruritu, & aliquando emittit saniem sed in qua cumq; istarum sit cum hac cura medemur capillorum euulsionem

*Cura.*

**R**Ecipe emplastrum albi, picis naturalis añ unc 1 nucum communium uncias sex, hæc terantur & in simul incorporentur bene ad modum argenti, quod si fuerit opus in hyeme, extrahatur oleum ex ipsis nucibus, & ipso

# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED IRWIN, M.D. FACS OMAHA, NEBRASKA

### THE SURGERY OF ROLAND OF ITALY

**R**OLAND of Parma was an Italian surgeon who achieved great prominence during the 13th century. Some of this reputation was due to reflected glory from his master and predecessor the great Roger upon whose work his writings are based some of them being copies word for word. Roland was born at Parma and spent part of his life there and part in Bologna where he was a teacher in the great school. So far as is known he did not travel but as the Arabian surgery had already been brought to Italy he was able to study the translations made by Constantinus Africanus and add the teaching of the Arabian school to that of the Italian. His work attained great reputation in the middle ages and was included in the *Codex* from which the lecture at the School of Salerno were given. It was called by a special name *Rolandina*. The work of course existed only in many script form for many years and was first printed in 1499 as a part of the Venetian collection of Surgery (*Collectio chirurgica Veneta*). It was also included in the commentaries of the four masters in the *Collectio Salernitana*. It was subsequently reprinted under the title *Humani Corporis inferiorum et exteriorum morbis medendi ratio methodica aulice Rolando* by Henricus Petrus at Basle in 1541.

Looking over these old books bring up an interesting point with reference to the development of surgery. It is the synchroism between that part of surgery which at the time commanded the greatest amount of attention and the development in the art of making war. At first glance this may seem peculiar and far fetched but more careful observation establishes certain phases in surgical procedure which go hand in hand with the forms and methods of warfare. When we examine a book on surgery of the time of Roland we find the subject which receive the greatest amount of attention to be fractures of the skull and wounds of the head. This portion of surgery has reached a high standard when compared with others. This remains true for some years and why?

Turning for a moment to the times we realize that this was a period immediately following the age of chivalry. Then knights in full armor carried on war. The weapons were the lance the mace and the battle axe and the methods were those of the

tournament and joust. The warriors were almost all mounted and the head was the part aimed at. Consequently the majority of casualties were head injuries contusions concussions and fractures. This type of trauma therefore made up a large part of the practice of the surgeon of the time and naturally this fact was reflected in his writings. A little later the subject that we find assuming major proportions is of wounds caused by darts and arrows and history tells us of the improvement of the short bow of Hastings into the famous long bow with its tremendous power for shooting arrows. Next in order is the invention of the hargrebeuse with its use of gunpowder and bullets and the works of the surgeons of the sixteenth century take up the surgical problems arising because of wounds of this character methods of prognosis for bullets the invention of forceps for their removal the ligation of injured vessels and others. Surgery and warfare therefore proceed hand in hand even to and including modern times. It is necessary only to turn back to the literature of eight or nine years ago and read of the terrible compound comminuted fractures on the one hand and gas poisoning on the other to realize that there had been changes in the art of warfare.

So we find that Roland devotes his first book to the surgery of the head in which he includes mania melancholia epilepsy and disease and injuries of the eye and nose. His knowledge of the important clinical signs in head injuries is considerable and his differentiation from a prognostic standpoint is keen though of course his physiological basis is not particularly sound. Thus in his first paragraph he states that fracture of the skull may occur either with or without a wound of the scalp that the wound if present may be large or small but in any event the important thing is neither the wound nor the fracture but whether or not the coverings or substance of the brain are injured. He differentiates between lesions of the dura and pia mater. In injury to the aura he states that there is pain in the head redness of the face inflammation of the eye wandering of the mind and blackness of the tongue. When the pia is injured however there are loss of consciousness loss of voice pustules on the face blood and serum flowing from nose and ears constipation and when the injury is severe a rigor of the body which is a certain sign of death. The work is interesting and in itself shows why Roland was considered a master in his time.

## REVIEWS OF NEW BOOKS IN SURGERY

**F**REQUENTLY the medical society is favored with a paper on the Acute Abdomen. This will no longer be necessary for within the reach of every medical student and general practitioner lies Cope's neat monograph of just over 200 pages dealing with this subject of early diagnosis quite completely.

In an orderly and easy style the author discusses the principles of diagnosis in acute abdominal disease the method of diagnosis including history taking and examination. Then follows in order the common causes of acute abdominal disease starting with appendicitis and giving a differential diagnosis.

With only one statement do we disagree. In these United States we find that in a majority of instances the intestinal obstruction follows a previous operation usually on a woman a finding at variance evidently with that in England where the author resides.

KELLOGG SPOFF

**P**ATHOLOGY is the foundation of Kopetzky's excellent volume. Symptoms and findings are closely correlated with the underlying disease processes and specific surgical relief advised for the specific condition. The author defines more carefully than usual the different types of disease and attempts to define the procedure for each situation. This effort to particularize to work out the exact pathology with its special operative relief is one of the very good features of the book.

The work is well done thorough very informative with adequate anatomical description and full detail of surgical technique usually supplemented by clear illustrations. All of the standard methods are described with good discussion of the relative merit of each. Controversial points are for the most part judiciously considered with fair citations from the literature and the author supports his position from his own large experience with many case reports.

Some of his ideas may be considered revolutionary as for instance his conception of hemorrhagic (septic) mastoiditis is a condition requiring intervention almost at the onset of the initial attack. His ideas have at least had a considerable influence in emphasizing the danger of too complacent delay in such cases. Although some authorities may not be so ready as he to intervene it must be a limited effort. He has made a good attempt to rationalize the indications for the time and type of operation.

Some of the sentence structure is perhaps unnecessarily heavy some descriptions are not very clear and the relations of some chapter subheadings not definite. On the whole however this appears to be a valuable book which should be read by any one who does otologic surgery.

J. C. CALLOWAY

THE L. D. O. THE ACUTE ABDOMEN. By Z. H. Cope. 2nd ed. (London) F.R.C.S. (Eng.) 3rd ed. 1910. 2nd ed. 1910. Oxford University Press. 5s.

OTITIC SURGERY. By Samuel J. Kopetzky M.D. F.R.C.S. (London) 1911. 11s. 6d.

**I**N their preface to the first edition of *An Index of Treatment* the editors state that the work is intended for the general practitioner as a guide for treatment. They frankly admit that a work such as this is bound to be marked by some omissions. The present volume 1 of encyclopedic dimensions containing over one thousand pages. Among the contributors one finds the best known English medical writers. The subjects are treated in an alphabetic order so that one finds on the same page acidosis and acne vulgaris. Addison's disease is followed by adenoids. The analogy to a dictionary forces itself upon the reviewer and yet one must admit the usefulness of the arrangement in a work of this type. Most of the chapters are well written within their necessarily limited space. On the whole it appears that the medical subjects are treated more adequately than the surgical. One might point out for instance that in the discussion of hamatemesis from gastric ulcer (p. 379) blood transfusion is not mentioned. Quite disappointing is the chapter on exophthalmic goiter. Its author does not seem to be aware of the brilliant achievements in this field of surgery brought about by the proper pre-operative use of Lugol's solution followed at the height of improvement by a radical thyroidectomy. Instead he recommends a fair trial of medical treatment roentgenotherapy arsenic etc. This chapter surely needs to be rewritten. In spite of a few such imperfections the work is well done. It contains a vast amount of information in a form which affords the practitioner easy access.

GEORGE HALPERIN

**T**HE radiological investigation of the male urethra is the theme of a monograph by Kohnstamm and Cave.

The authors have developed a technique which from their description is quite simple and easily followed. They recommend the use of lipiodol a compound of 40 per cent iodine in oil of poppies as the best contrast medium for this work. It being less irritating and producing a much denser shadow than other solutions that have been used. They have developed a special apparatus for injection while plates are being made so that the entire urethra is filled with the solution at the time of exposure. At least three exposures are taken (1) posterior anterior (2) right oblique (3) left oblique. A fourth to demonstrate residual urine is taken after the patient has evacuated.

By this method many very interesting pathological lesions of the urethra and prostate are shown such as

THE L. D. O. THE ACUTE ABDOMEN. By Z. H. Cope. 2nd ed. (London) F.R.C.S. (Eng.) 3rd ed. 1910. 2nd ed. 1910. Oxford University Press. 5s.

OTITIC SURGERY. By Samuel J. Kopetzky M.D. F.R.C.S. (London) 1911. 11s. 6d.



# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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DAVID W MACKENZIE  
OSCAR F MERCIER

EUGENE SAINT JACQUES  
WILLIAM G TURNER

## 1926 CLINICAL CONGRESS IN MONTREAL

THE sixteenth annual Clinical Congress of the American College of Surgeons will be held in Montreal Quebec October 25 to 29 1926 inclusive. The committee on arrangements under the leadership of Dr Alfred T Bazin is preparing a program of clinics and demonstrations to be given in the hospitals and medical schools that will adequately represent the clinical activities of Canada's great medical center. All departments of surgery will be included: general surgery, gynecology, obstetrics, orthopedics, urology and surgery of the eye, ear, nose, throat and mouth. It is expected that a preliminary clinical program will be published in the next issue of this journal.

Since the 1920 session of the Clinical Congress in Montreal a number of new hospitals have been built and additions made to the older hospitals so that the clinical facilities in that city have been materially increased. Those who attended the 1920 session will recall with great pleasure the splendid clinical program offered by the surgeons of Montreal and one may confidently expect that the program for this year's session will provide a larger and still more interesting series of clinics.

A committee of which Dr Albert LaSalle, ophthalmic surgeon to Hotel Dieu, is chairman, is preparing a special program of clinics, demonstrations and papers that will be of particular interest to visiting surgeons who practice surgery of the eye, ear, nose and throat.

Clinics and demonstrations are to be given at the following institutions: McGill University

and University of Montreal medical schools and the Children's Memorial Hotel Dieu, Misericordia, Montreal General, Notre Dame, Royal Victoria, Saint Justine and Shriners hospitals.

The executive committee of the Clinical Congress is preparing programs for the scientific meetings to be held each evening in Windsor Hall at the Windsor Hotel. At these evening sessions papers dealing with surgical questions of present day interest will be read and discussed by eminent surgeons of the United States and Canada and by distinguished surgeons from abroad.

At the presidential meeting to be held on Monday evening in Windsor Hall the President Elect Dr Walter W Chipman of Montreal will be inaugurated and deliver the annual address. In the same room on Friday evening will be held the fourteenth annual convocation of the College.

The annual conference on the hospital standardization program of the College and the problems related thereto will be held in Windsor Hall at the Windsor Hotel on Monday and Tuesday, occupying both the morning and afternoon hours. The program for this conference will be published shortly and will outline an interesting series of papers and discussions of matters related to the conduct of hospitals presented by surgeon, superintendents, nurses, trustees and others.

General headquarters for the Congress will be established at the Windsor Hotel on Dominion Square where the Windsor Hall, Rose Blue and



the size and position of false passages the location and size of strictures and the hypertrophied prostate

A description of the normal urethra and prostate and a number of physiological facts suggest new methods and objections to some old practices in the treatment of diseases of the prostate urethra and seminal vesicles

The monograph is profusely illustrated with photographs diagrams and plate studies of the normal as well as the pathological conditions The authors have at least laid a very good foundation for future study in the use of the roentgen rays for the differential diagnosis of conditions of the male urethra

B C CUSHWAY

## BOOKS RECEIVED

Book received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender Selections will be made for review in the interests of our readers and as space permits

**THE DIAGNOSIS AND TREATMENT OF TUBERCULOSIS OF THE LUNG** By G R Girdlestone M D (Dron.) F.R.C.S. New York Oxford University Press 1925

**REPORT OF THE SCIENTIFIC WORK OF THE SURGICAL STAFF OF THE WOMAN'S HOSPITAL IN THE STATE OF NEW YORK** Edited by George Gray Ward M.D. Vol. V 1923-1924 St Louis The C V Mosby Company 1925

**PROCEEDINGS OF THE NINETEENTH ANNUAL MEETING OF THE ASSOCIATION OF LIFE INSURANCE PRESIDENTS HELD IN THE HOTEL ASTOR** New York 1925

**SEI TUMORI AD ETIOLOGIA POST TRAUMATICA** Dott Piero Alonso

**A HANDBOOK FOR SENIOR NURSES AND MIDWIVES** By J N Watson M.D. (Edin.) Capt. P A M C New York Oxford University Press 1926

**THE PATHOLOGY OF TUMOURS** By E H Kettle M.D. B.S. (Lond.) 2nd ed New York Paul Hoeber Inc 1925

**BIOLOGIE UND PATHOLOGIE DES WEIBES** etc. By Josef Hiltner and Ludwig Seitz Berlin Urban & Schwarzenberg 1926 Lieferung 21

**ÉTUDE ANALYTIQUE ET SYNTHÉTIQUE DE LA SYMPATHÉTOMIE PÉRIARTÉRIELLE APPLIQUÉE AU TRAITEMENT DES VÉGÉTATIONS CHRONIQUES DES MEMBRES INFÉRIEURES** etc. By Dr Guillermo Garcia Diaz Paris Le Frangois 1925

**THE MELANOMATA THEIR MORPHOLOGY AND HISTOGENESIS** By James W Dawson M.D. D.Sc. F.R.C.P.E. Edinburgh Oliver and Boyd 1925

**OPERATIVE CYSTOSCOPY** By E Canny Ryall F.R.C.S. St Louis C V Mosby Co 1925

**CANCER OF THE RECTUM** Letchman lectures delivered before Medical Society of London February 19 March 7 and March 26 1923 By W Ernest Miles F.R.C.S. London Harrison and Sons Ltd 1926

**RECENT ADVANCES IN OBSTETRICS AND GYNECOLOGY** By Aleck W Bourne B.A. M.B. B.Ch. (Camb.) F.R.C.S. (Eng.) Philadelphia P Blakiston's Son & Co 1926

**THE EVOLUTION OF ORTHOPEDIC SURGERY** By Robert B Osgood M.D. St Louis The C V Mosby Co 1925

**MANIPULATIVE SURGERY PRINCIPLES AND PRACTICE** By A G Timbrell Fisher M.C. F.R.C.S. (Eng.) New York The Macmillan Company 1926

**TRANSACTIONS OF THE AMERICAN PROCTOLOGICAL SOCIETY TWENTY SIXTH ANNUAL SESSION MAY 25-26 1925** New Bedford Massachusetts George H Reynolds 1926

**TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY VOLUME 50 1925** Edited by Arthur H Curtis M.D. Philadelphia W J Dorman 1925

**THÉRAPEUTIQUE CHIRURGICALE** By P Lécène and R Lenche Vol. III—Addimen et Organes Genito-Urinaires Vol. Lécène Paris Masson et Cie 1926

**INTERNATIONAL CLINICS A QUARTERLY** Edited by Henry W Catell M.D. Vol. 1 1926 Philadelphia and London J B Lippincott Company 1926

**A DIGEST AND AN EDITORIAL ARTICLE OF THE FEDERAL NARCOTIC LAWS AS THEY APPLY TO DOCTORS OF MEDICINE** Los Angeles California Los Angeles County Medical Association November 1925

**FACTS OF THE HEART** Richard C Cabot M.D. Philadelphia and London W B Saunders Company 1926

**GASTRIC FUNCTION IN HEALTH AND DISEASE** By John A Pyle M.D. (Lond.) F.R.C.P. New York Oxford University Press 1926

**LOCAL FIELD STUDIES** By Ralph I Lloyd M.D. F.A.C.S. New York The Technical Press 1926

**YOUNG'S PRACTICE OF UROLOGY BASED ON A STUDY OF 12,500 CASES** By Hugh H Young and David M Davis with Collaboration of Franklin P Johnson Vols I and II Philadelphia and London W B Saunders Company 1926

**AN INTRODUCTION TO SURGERY** By Rutherford Monson M.D. F.R.C.S. (Edin.) F.R.C.S. (Eng.) M.A. D.C.L. LL.D. and Charles F M Saint CBE. M.D. M.S. F.R.C.S. (Eng.) 2nd ed New York William Wood and Company 1925

**CAESAREAN SECTION** By Herbert P Spencer M.D. F.R.C.P. New York William Wood & Company 1925

**MANUAL OF EMERGENCIES MEDICAL, SURGICAL AND OBSTETRIC THEIR PATHOLOGY DIAGNOSIS AND TREATMENT (BASED UPON LENZMAN'S EMERGENCIES IN MEDICAL PRACTICE)** By J Snowden M.D. M.R.C.P. 2nd ed New York William Wood and Company 1926

**PERIPHERAL SEPTICÆMIA ITS CAUSATION SYMPTOMS PREVENTION AND TREATMENT** By George Geddes M.D. M.A. New York William Wood and Company 1925

**HANDBOOK OF DISEASES OF THE RECTUM** By Louis J Hirschman M.D. F.A.C.S. 4th ed rev. St Louis The C V Mosby Company 1926

**MODERN METHODS OF AMPUTATION** By Thomas G Orr A.B. M.D. F.A.C.S. St Louis The C V Mosby Company 1926

**THE MEDICAL DEPARTMENT OF THE UNITED STATES ARMY IN THE WORLD WAR** Vol. VI—Field Operations Prepared under the direction of Maj Gen M W Ireland by Col Charles Lynch M.C. Col Joseph H Ford M.C. Lieut Col Frank W Weed M.C. Washington Government Printing Office 1925

**LES RÉSULTATS ACTUELS DU TRAITEMENT CHIRURGICAL DE L'ANGÈRE DE POITRINE** By Dr Reue F Staine Strasbourg University of Strasbourg Publications



Oak rooms, and other large rooms and foyers located on the ground floor have been reserved for the exclusive use of the Congress. More than a million dollars has been expended in recent years in remodeling and enlarging the Windsor Hotel. It is now under the same management as the Waldorf Astoria in New York, the Bellevue Stratford in Philadelphia and the New Willard in Washington.

The hotel situation in Montreal has been greatly improved by the erection of a new hotel with over 1,200 rooms—the Mount Royal—located on Peel Street two blocks north of the Windsor Hotel. The Queen's Hotel on Peel street near the Bonaventure Station two blocks from the Windsor has been remodeled and a new section added that doubles the capacity of that hotel.

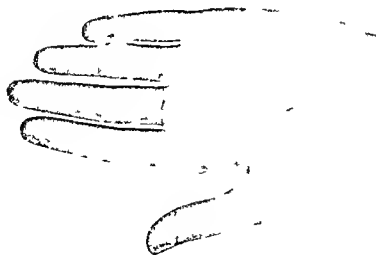
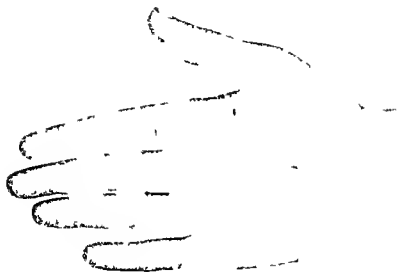
In addition to the hotels named above rooms have been reserved at the Ritz Carlton located at the corner of Mountain and Sherbrooke streets four blocks from the Windsor Hotel, the Corona on Guy Street and the Place Viger. We are assured of ample comfortable accommodations at these hotels for more than 3,000 and with the exception of the Place Viger all of the hotels mentioned are within short walking distance of headquarters.

Following the plan in effect at all sessions in recent years it will be necessary to enforce strictly the rule limiting attendance at the Congress to a number that can be comfortably accommodated at the clinics. The limit of attendance will be based on the result of a survey of the operating rooms, amphitheaters, lecture rooms and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. This plan necessitates registration in advance on the part of all who wish to attend the Congress. When the limit of attendance has been reached through advance registration no further application can be accepted.

Attendance at all clinics and demonstrations will be controlled by means of clinic tickets to insure against overcrowding and to provide for the distribution of visiting surgeons among the several clinics. The number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic is to be given.

An application will be made to the railways of the United States and Canada for reduced fares on account of the meeting in Montreal and it is practically assured that a rate of one and one-half the regular one way fare will be authorized for this occasion under the same conditions as have prevailed at sessions in recent years.





# SURGERY, GYNECOLOGY AND OBSTETRICS

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## SYMPATHECTOMY IN RAYNAUD'S DISEASE, ERYTHROMELALGIA, AND OTHER VASCULAR DISEASES OF THE EXTREMITIES<sup>1</sup>

By LOYAL DAVIS, M.D., PH.D., AND AILEN B. KANAVEL, M.D., F.A.C.S., CHICAGO

**S**URGERY is now in the midst of a period of enthusiasm over operative procedures directed toward the sympathetic nervous system. A voluminous literature deals with the practical results of peripheral sympathectomy in a wide variety of diseases but in particular those in vascular and trophic lesions of the extremities. Because of the paucity of our knowledge of the anatomy and physiology of the sympathetic nervous system there is necessarily a mass of empirical clinical data. It follows that our knowledge of the role of the sympathetic system in pathological conditions is likewise meagre. Our attention was first directed to the peripheral effects of sympathectomy in an experimental and clinical study of the results produced in spastic diseases of the extremities by removal of the sympathetic trunks, their rami and ganglia. We wish to record our experiences and impressions obtained in removing the influence of the sympathetic innervation to an extremity in Raynaud's disease, erythromelalgia and other vascular diseases of the extremities.

### ANATOMY AND PHYSIOLOGY

It would seem fundamental to have clearly in mind in just what manner the blood vessels of the extremities receive their innervation. The physiological work of the nineteenth century brought out the now commonly accepted fact that the muscular action of the blood ves-

sel walls is under the control of the sympathetic nervous system.

It will be remembered that the sympathetic nervous system is composed of a craniosacral and a thoracolumbar outflow. These two portions differ from one another anatomically, physiologically and in their reactions to the administration of drugs. The craniosacral outflow has received the name parasympathetic in contradistinction to the thoracolumbar division which has been termed the 'sympathetic' division. We are concerned with the thoracolumbar outflow of fibers. Within the intermediolateral cell column of the anterior horn of grey matter in the thoracic and lumbar portions of the spinal cord are found the cells of origin of the fibers of this division of the sympathetic nervous system. These fibers leave the spinal cord through the anterior or motor roots and reach the sympathetic ganglia situated paravertebrally. Here they end to form a synapsis with the dendrites of a sympathetic ganglion cell. These small myelinated fibers constitute the preganglionic sympathetic nerve fibers and make up the white rami communicantes. From the sympathetic ganglion fibers arise which join the spinal nerves. These postganglionic fibers are unmyelinated and form the grey rami communicantes. Some of these postganglionic fibers proceed directly to the structures which they innervate while the majority join the spinal nerves.

It will be seen that as far as our knowledge now goes the sympathetic nervous system is purely an efferent one. The possibility of antidromic afferent conduction will be spoken of later.

The vessels of the extremities receive a sympathetic innervation through the somatic nerves and this supply is received at regular segmental levels. In addition there may be a direct supply from the sympathetic ganglion cells by a fine plexus of fibers within the sheath of the arteries. The question of the existence and importance of these two types of innervation has been a mooted one for many years. Kramer and Todd (15) studied the distribution of the vasomotor nerves to the arm and Pott (22) made a similar study upon the leg. In both instances the conclusions were identical—that the nerve fibers are supplied to the blood vessels at regular levels in their course and that only a small number of fibers accompany the large arteries to end in the arterioles and capillaries. Langley (17) stimulated the lumbar sympathetic chain before and after section of the femoral and sciatic nerves. Pallor of the foot was obtained before cutting these nerves and was abolished after section. He also injected ergotamine and then stimulated the lumbar sympathetic chain. Upon the side of the cut peripheral nerves there was no effect while flushing occurred upon the opposite side. He concluded that the vascular sympathetic fibers run to the trunk and limbs by the somatic spinal nerves and not by way of the arteries.

Milko (20) stimulated the sheath of the femoral artery in dogs and secured no changes in volume of the leg. However vasodilatation was obtained after the sciatic nerve was severed. Schiff (24) secured no increase in the cannulated blood flow in dogs upon stimulation of the sheath of the femoral artery. Bowring (2) made plethysmographic studies upon the dog's leg and found that all of the vasomotor reflexes are maintained after periaortic sympathectomy and are abolished by interrupting the mixed peripheral nerves. He stated that the fibers for these vascular reflexes do not accompany the vessels but join them only upon reaching the periphery. Wiedenkopf (1) has shown that anesthesia of the

brachial plexus in man produces the same changes in the arm as does removal of the sympathetic chain. These effects cannot be obtained by removing the adventitia of the vessels. Denning (8) sectioned the femoral nerve below Poupart's ligament and the sciatic nerve in the middle of the thigh in dogs. He then exposed the femoral artery and vein and drew a rubber tube beneath them. He ligated the extremity *en masse* without including the vessels. After these procedures he injected barium chloride into the tibial artery. Contrary to the normal results there was no painful reaction. He concluded that the sensory nerves of vessels of the lower extremity run with the spinal nerves. Jones (14) has insisted upon the presence of a perivascular nerve plexus which anastomoses along the entire length of the vessel. He described the presence of sympathetic ganglion cells within this perivascular plexus. Diaz (9) states that these are not true ganglion cells but are entirely different from sympathetic ganglion cells in their structure and size. He states that they are similar to those cells found in the sinusoidal node and in the wall of the auricle of the heart. Guillaume (11) has carried out very careful microscopic dissections of the larger vessels of the extremities. He believes that stripping the wall of an artery does not completely remove the innervation to that vessel. He states that removing this adventitia over a small length of the vessel cannot possibly interrupt fibers going to the rest of the extremity. This author admits that there is a fine plexus of fibers in the sheath of the peripheral artery which divides into innumerable branches but strongly emphasizes that the majority of the vascular innervation comes to the vessels in a segmental distribution from the spinal nerves. In this connection it is interesting to note that in median nerve lesions Crile (7) has recently called attention to the development of cyanosis accurately delimited to the cutaneous area supplied by the median nerve following the application of the cuff of a sphygmomanometer to the arm and inflation to equal the patient's diastolic blood pressure. This phenomenon disappeared as evidences of regeneration of the nerve appeared.

From a study of the literature on the subject it would appear then that there can be no question that the peripheral vessels receive their major sympathetic innervation by a segmental distribution from the spinal nerves and that these fibers originate from the sympathetic ganglia of the thoracicolumbar division as postganglionic fibers. There is a serious doubt as to the presence of a sympathetic innervation in the adventitia of the vessel which continues throughout its course. It would be difficult to conceive of how under such circumstances the removal of a small portion of the vessel adventitia could affect the caliber of the vessel at a distance. However we must take into consideration the reports of hyperæmia and temperature changes produced in the hands and feet of patients after such an arterial decortication.

In 1913 Lenche (19) called attention to the results he had obtained in man by thoroughly removing the periarterial sympathetic fibers about the femoral artery. He called particular attention to an hyperæmia produced by vasodilatation and to an increased warmth of the extremity undoubtedly produced by the same mechanism. Lenche reported the beneficial and curative effects of such a procedure in many clinical entities. He was quite unable however to verify these findings upon experimental animals. Nevertheless Lenche has stated that in man the predominant vasomotor influences are carried by the perivascular sympathetic nerves.

In considering the clinical results obtained by supposedly interrupting the sympathetic supply to the blood vessels one is immediately struck by this complete absence of any basic experimental physiologic work upon which the beneficial results may be explained. Certainly now here is there any experimental confirmation of Lenche's statement that in man the predominant vasomotor impulses are carried in sympathetic fibers found in the blood vessel adventitia.

Callander (4) found no rise in the systolic blood pressure in man after arterial decortication and in only one case could he find an increase in temperature in the operated upon extremity. Lehman (18) working upon animals could not corroborate the findings of

vasodilatation increase in blood pressure or temperature in the limb operated upon. He also denied any beneficial effect of arterial sympathectomy upon wound healing. Bowmg and Wiedkopfs (2-7) plethysmographic studies upon animals failed to confirm any of the reported results following periarterial sympathectomy. Elving (10) directly examined the capillaries following decortication of the vessel walls. He noted improvement of the circulation in four cases, a decrease in two and no change in six. Any of these results may be explained by Sherrington's work in which he demonstrated that freshly excised arteries show different diameters under the same wall tension when they have no sympathetic connections. Mosser and Taylor (21) performed an arterial decortication upon ten cats and five dogs. In only two did they find an appreciable temperature increase.

This experimental work merely confirmed Langley's statement that all vasomotor impulses leave the spinal cord by way of the white rami reach the sympathetic ganglia are relayed through the grey rami to the spinal nerves and thus reach their peripheral destination. It came to be believed that dilatation of arteries is produced only by paralysis of the normal vasoconstrictor fibers which have their origin in the sympathetic ganglion cells.

In 1874 Goltz sectioned the sciatic nerve and obtained a vasodilatation and a rise in temperature in the corresponding limb. Tewaschew (26) obtained similar results after cutting the femoral nerve and the opposite effects upon stimulation of the peripheral end of the divided nerve. Taylor and Rice (25) and Mosser and Taylor (21) have uniformly obtained an increase in the temperature of an extremity following an alcoholic injection of the sciatic nerve with a strong enough solution to produce a paralysis. They found that the minimum concentration necessary to produce paralysis produces a maximum hyperthermia.

Severance of the posterior root of the trigeminal nerve very commonly produces a vasodilatation and an increase in temperature upon the affected side. This is an observation we have made in many cases following posterior root section for the relief of trigeminal neuralgia. These results may be explained



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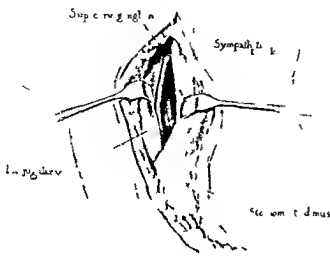


Fig. 2. Position of cervical sympathetic trunk lying beneath the lateral edge of the internal jugular vein.

packed with red cells which indicates the presence of a chemical influence.

Further we must not lose sight of other physiological factors which may play a very prominent part in the interpretation of circulatory diseases of the extremities. We cannot deny the influences of the frequency and force of the cardiac action, the viscosity of the blood, the quantity of the blood, the changes in the circulation of the blood under various conditions and the changes in cardiac muscle work. As a result we must recognize the apparent inadequacy of any surgical procedure in which an attempt is made to alter peripheral vascular resistance to affect materially the clinical course of such diseases.

Consequently basing our surgical procedures entirely upon known anatomical and physiological facts we have attempted to record our observations in vascular diseases of the extremities after removal of the sym-

pathetic ganglia and their rami. This principle of attack to our mind removes the major sympathetic innervation to an extremity without in the least impairing the somatic nerve supply. We believe that any surgical attack upon the sympathetic system may be applied only to those diseases of the extremities in which organic lesions of the vessels cannot be demonstrated. It is illogical to attempt to produce changes in muscular contractility in the walls of vessels in which definite pathological changes have taken place. Therefore we should exclude thromboangitis obliterans, arteriosclerosis, luetic arteritis and possibly scleroderma and chronic asphyxia. While many authors deny their recognition as clinical entities we may include erythromelalgia, Raynaud's disease and acroparesthesia as diseases suitable for surgical attack. The symptomatology in these conditions has been referred to disturbances in the entire sym-

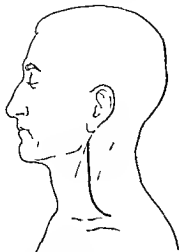


Fig. 1. Skin incision employed to locate and remove cervical sympathetic trunk.

upon the work of Bayliss and Bruce who have demonstrated the existence of vasodilator impulses which travel antidromically along a sensory nerve fiber. It would seem therefore certain that vasodilatation with its accompanying phenomena in an extremity is not entirely dependent upon the periarterial sympathetic innervation and it is probable that there is very little dependent upon any such innervation of the blood vessel wall. On the other hand it appears equally as definite that these phenomena are regularly obtained through the agency of both purely motor sensory or mixed nerves of cerebrospinal origin. However it must not be forgotten that clinical observations are on record in which removal of the vessel adventitia has produced an increase in the local temperature hyperæmia and a change in the nutrition of the tissues. After removal of the cervical and lumbar sympathetic chains in patients who have had spastic extremities we have recorded a definite vasodilatation and hyperæmia noted particularly in the sclera of the eye and in the skin of the extremity. In addition there has been an accompanying elevation in the surface temperature of from 1.0 to 1.5 degrees. We have also recorded the fact that these effects are transient and disappear from within one to two weeks when the normal relations are

re established. We have observed a hyperæmia and dilatation of the vessels of the sclera and nictitating membrane in cats following removal of the superior cervical sympathetic ganglion and chain but have found no corresponding increase in the surface temperature. The animal's furry protection may of course explain the lack or non development of a regulatory skin vasomotor mechanism. The observations should not be lost sight of and attempts must be made to supply their explanation.

For our part we can understand how removal of the sympathetic ganglia or interruption of their ramus communicans might produce whatever physiological results are to be found in the entire extremity. On the other hand in view of the known anatomical and physiological facts we cannot conceive of how the interruption of the minor portion of the vascular sympathetic innervation from a local segment of an artery can affect the most distal portions of the extremity.

In the consideration of vascular diseases of the extremities with symptoms and signs of deranged circulation it is necessary to take into account the physiology and pathology of the capillary system. From the work of Hooker (12) Krogh (16) Rouget (23) and others it is believed that the capillaries are definitely capable of active alterations in their caliber. From this experimental work it is evident that these structures are controlled by nerve impulses and by direct mechanical and chemical stimuli. It has been shown that stimulation of the sympathetic innervation produces an active capillary constriction. On the other hand stimulation of sensory spinal nerves results in a capillary dilatation through the mechanism of an antidromic conduction in these fibers. In a study of dermatographia Cotton Slade and Lewis (6) have shown the effects of mechanical irritation of the skin which they believed were due to capillary constriction or dilatation. According to the recent views of Krogh (16) Hooker and Dale (13) the capillaries are influenced by chemical stimuli. It has been shown that histamine for example produces a marked capillary dilatation. Cannon (5) has presented evidence that in wound shock, the capillaries are

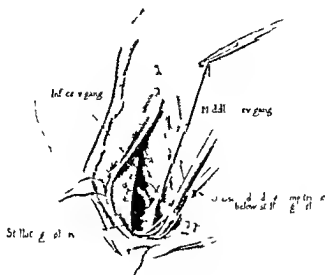


Fig 4 Retraction upward and laterally brings the stellate ganglion into view and its ramus may be easily severed

jugular vein medially and at the same time rolling its posterior surface forward the cervical sympathetic chain may be seen lying beneath the lateral edge of the vein on the scalenus muscle (Fig 2). By dissecting upon the medial edge of the sternomastoid any danger of injuring the spinal accessory nerve is avoided. The sympathetic trunk may be isolated by blunt dissection and followed as it passes laterally and downward beneath the sternomastoid muscle. If any difficulty is experienced in recognizing the sympathetic trunk one may dissect upward and identify the superior cervical ganglion and proceed from that landmark. The trunk may be divided and passed beneath the muscle and delivered into the field by gentle outward and upward traction. At the same time the lateral and inferior edge of the sternomastoid is retracted medially. In this position the inferior thyroid artery passes transversely across the field from its origin from the thyro

cervical axis. The middle cervical sympathetic ganglion is usually in close association with this vessel and may encircle it. Medial laryngeal branches as well as the superior and middle cardiac nerves arise from the sympathetic trunk near this ganglion (Fig 3). The chain is then followed further inferiorly behind and below the clavicle. The apical pleura soon enters the field and should be protected. As one bluntly dissects downward the trunk must not be confused with the cardiac nerves which are almost of equal size. The parent trunk holds a more posterior position. The next structure encountered before reaching the stellate ganglion is the small inferior cervical ganglion. This may be fused with the stellate and if separate lies immediately superior to the latter. At this point the vertebral artery may be seen in the field lying medially. By exerting gentle traction upward and outward during this dissection and dividing the ramus from the trunk and ganglia the

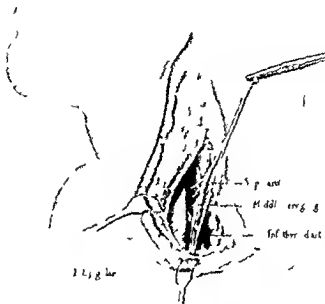


Fig. 3. Relation of the middle cervical sympathetic ganglion to the inferior thyroid artery.

thetic nervous system and the importance of the relationship of the endocrine glands has been emphasized by some individuals.

#### SURGICAL PROCEDURES

In operations upon those patients in whom the symptoms involved the upper extremities we removed the stellate and inferior sympathetic ganglia, their branches and the intervening trunk. From one of these patients we removed the superior and middle ganglia in addition—we feel that this is quite unnecessary since the nerves of the upper extremity receive their sympathetic fibers entirely from the stellate ganglion. In addition we add the symptoms of a Horner's syndrome unwar-  
rantedly. In dealing with lesions in the lower extremity we have removed the lumbar sympathetic ganglia both by a lumbar and an intra-abdominal route. We prefer the former if we desire to produce an effect in only one extremity and the latter if we wish to remove

the sympathetic supply from both extremities during one operation.

#### TECHNIQUE OF CERVICAL SYMPATHECTOMY

An incision is made from the inferior angle of the mandible and on the medial edge of the sternomastoid muscle downward. The line of incision crosses the sternomastoid from its medial to its lateral edge in an oblique direction to reach the superior border of the clavicle. Here the incision turns laterally and the completed line therefore resembles a hockey stick (Fig. 1).

The fascia of the sternomastoid is exposed and the medial edge of the muscle is freed. If one desires to excise the superior cervical ganglion the incision should be carried upward toward the tip of the mastoid process. The carotid artery, jugular vein, and vagus nerve are now in the field of operation as the medial edge of the sternomastoid muscle is retracted laterally. By gently retracting the

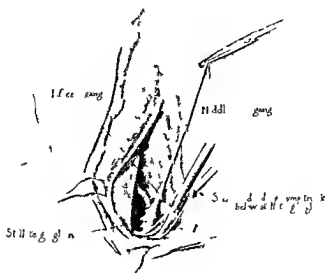


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stellate ganglion may be delivered into the field from its location on the tubercle of the first rib. This maneuver makes the removal much more simple. After dividing its ramus the sympathetic trunk is divided below the ganglion (Fig. 4).

The subcutaneous tissue and skin are closed in the usual fashion and a pad is bandaged in position to fit snugly into the suprasternal fossa. It will be recognized that this procedure may be modified as one desires to excise the stellate ganglion only or others of the ganglia and trunk. It is recognized that the upper extremity receives its sympathetic innervation from the stellate ganglion alone.

#### TECHNIQUE OF SYMPATHECTOMY BY THE ABDOMINAL ROUTE

A midline incision is made through the skin, fascia and peritoneum with the umbilicus about opposite the middle point. With the patient in the Trendelenburg position the intestines are packed upward and laterally to expose clearly the posterior peritoneal wall. The aorta, vena cava and ureters may be seen through the peritoneum.

A linear incision is made through the peritoneum over the medial edge of the psoas muscle (Fig. 5). This does not expose the ureter. The lumbar sympathetic trunk and ganglia lie upon the anterolateral surfaces of the vertebral bodies and are partially covered by the medial edge of the psoas and on the right side by the vena cava (Fig. 6). Because of the situation of the vena cava the right lumbar chain is more difficult to expose. The vena cava is gently retracted medially and at the same time is lifted up. The sympathetic ganglia and trunk may be seen clearly lying in a loose adventitious tissue. The trunk and ganglia bear a varying relation to the lumbar arteries and veins in that these structures may pass above or below the trunk (Fig. 7). The second lumbar ganglion usually lies just under cover of the inferior edge of the third portion of the duodenum. We have earned our excision upward to include the ganglion and have removed the chain as low as to include the fourth lumbar ganglion. This structure occasionally lies over the brim of the pelvis and it is necessary to protect carefully the blood

vessels. Any oozing encountered is easily controlled. We have never sutured the peritoneum but simply allow it to fall into place. The aorta does not overlie the trunk as does the vena cava and it is therefore much easier to remove the chain and ganglia upon the left side. The intestines are replaced and the wound is closed in the usual manner.

In this work we have removed the ganglia and trunk from the second to the fourth lumbar ganglia inclusive. It necessarily follows that the communicating rami are severed as their ganglion cells of origin are removed. This abdominal route of approach permits one to interrupt the sympathetic supply to both lower extremities through the same operative wound.

#### TECHNIQUE OF SYMPATHECTOMY BY THE LUMBAR ROUTE

This method of approach was first devised by Royle. A complete detailed description of this operation is given by this author in *SURGERY GYNECOLOGY AND OBSTETRICS* 1924 XXX 707. We have followed this same technique and have found it to be quite satisfactory. This operation is particularly useful and is indicated if one desires to remove the sympathetic supply from one extremity only. We have found it a trifle more difficult to remove the entire chain and ganglia from the second to the fourth lumbar ganglia inclusive by this method. The procedure is also rather difficult in large muscular or obese individuals. These small technical inconveniences are outweighed however by the smooth postoperative convalescence of patients who have been operated upon by this method as compared to those operated upon by the abdominal route.

#### CLINICAL CASES

*Erythromelalgia*.—Lumbar Sympathectomy.—R. J. In 1922 I. C. aged 35 a Russian Jewish tailor began to have an aching pain in his feet particularly after walking. This difficulty increased in frequency and intensity so that upon his entrance into the hospital walking four or five blocks caused him great discomfort and pain. Since 1924 he had noticed that his feet and particularly his toes became very red and purple in color. This was true when they were in a dependent position. This color disappeared if he elevated his feet. The redness of his toes and the dorsum of his foot was almost always confined to





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#### TECHNIQUE OF SYMPATHECTOMY BY THE ABDOMINAL ROUTE

A midline incision is made through the skin, fascia and peritoneum with the umbilicus about opposite the middle point. With the patient in the Trendelenburg position the intestines are packed upward and laterally to expose clearly the posterior peritoneal wall. The aorta, vena cava and ureters may be seen through the peritoneum.

A linear incision is made through the peritoneum over the medial edge of the psoas muscle (Fig. 5). This does not expose the ureter. The lumbar sympathetic trunk and ganglia lie upon the anterolateral surfaces of the vertebral bodies and are partially covered by the medial edge of the psoas and on the right side by the vena cava (Fig. 6). Because of the situation of the vena cava the right lumbar chain is more difficult to expose. The vena cava is gently retracted medially and at the same time is lifted up. The sympathetic ganglia and trunk may be seen clearly lying in a loose adventitious tissue. The trunk and ganglia bear a varying relation to the lumbar arteries and veins in that these structures may pass above or below the trunk (Fig. 7). The second lumbar ganglion usually lies just under cover of the inferior edge of the third portion of the duodenum. We have carried our excision upward to include this ganglion and have removed the chain as low as to include the fourth lumbar ganglion. This structure occasionally lies over the brim of the pelvis and it is necessary to protect carefully the blood

vessels. Any oozing encountered is easily controlled. We have never sutured the peritoneum but simply allow it to fall into place. The aorta does not overlie the trunk as does the vena cava and it is therefore much easier to remove the chain and ganglia upon the left side. The intestines are replaced and the wound is closed in the usual manner.

In this work we have removed the ganglia and trunk from the second to the fourth lumbar ganglia inclusive. It necessarily follows that the communicating rami are severed as their ganglion cells of origin are removed. This abdominal route of approach permits one to interrupt the sympathetic supply to both lower extremities through the same operative wound.

#### TECHNIQUE OF SYMPATHECTOMY BY THE LUMBAR ROUTE

This method of approach was first devised by Royle. A complete detailed description of this operation is given by this author in *SURGERY GYNECOLOGY AND OBSTETRICS* 1924 LXIX 707. We have followed this same technique and have found it to be quite satisfactory. This operation is particularly useful and is indicated if one desires to remove the sympathetic supply from one extremity only. We have found it a trifle more difficult to remove the entire chain and ganglia from the second to the fourth lumbar ganglia inclusive by this method. The procedure is also rather difficult in large muscular or obese individuals. These small technical inconveniences are outweighed however by the smooth postoperative convalescence of patients who have been operated upon by this method as compared to those operated upon by the abdominal route.

#### CLINICAL CASES

##### *Erythromalgia—Lumbar Sympathectomy—Relief*

In 1922 P. C. aged 35 a Russian Jew tailor began to have an aching pain in his feet particularly after walking. This difficulty increased in frequency and intensity so that upon his entrance into the hospital walking four or five blocks caused him great discomfort and pain. Since 1924 he had noticed that his feet and particularly his toes became very red and purplish in color. This was true when they were in a dependent position. This color disappeared if he elevated his feet. The redness of his toes and the dorsum of his foot was almost all days confined to

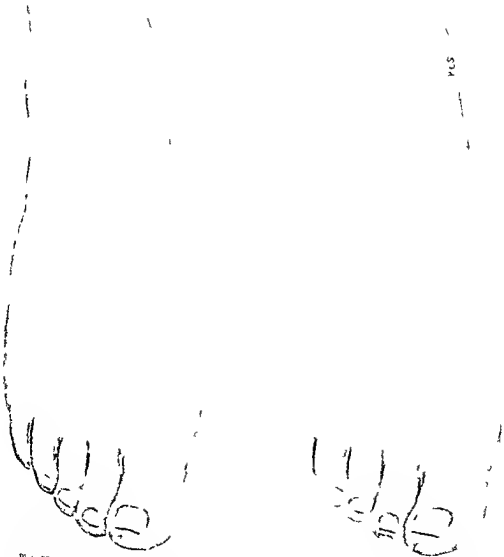


Plate II. Foot of patient with erythromelalgia before and after removal of right lumbar sympathetic chain and ganglion.

Sympathetic in Raynaud's Disease, Erythromelalgia, and Other Vascular Disorders of the Extremities—Loyal Davis and Allen B. Kimball



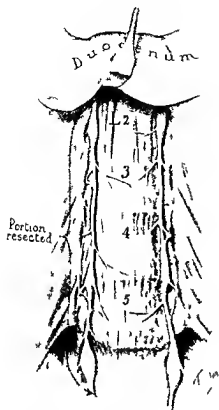


Fig 6 Relation of the lumbar sympathetic trunk to the psoas muscle and vena cava

become discolored only over the distal phalanges. During this attack the radial pulse is full and strong. The fingers feel cold and clammy. They are very tender to the slightest pressure, particularly over the extremities. The tips of the fingers and thumbs are hard and boardlike and are very painful at all times but more so during an attack. The skin in these areas is scaly and indurated. The tip of the right index finger is ulcerated. The end of the distal phalanx is exposed. This has been in this condition for 3 weeks and resulted from a rather insignificant trauma. All of the peripheral pulses could be palpated with ease.

A tourniquet was applied to both arms but no hyperemia could be produced after its release. X-ray plates of the arms showed no evidence of vessel calcification. X-ray plates of the hands did not show an atrophy in the tips of the distal phalanges characteristic of Raynaud's disease in the later stages.

The basal metabolic rate of the patient upon several occasions was plus 12. Blood chemistry examination showed non protein nitrogen of 27.4

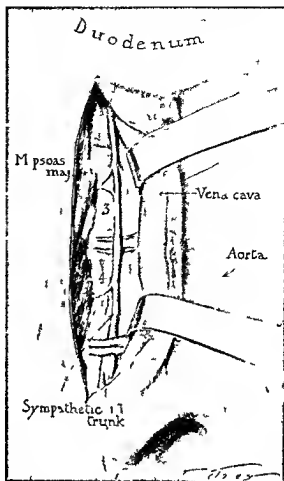


Fig 7 Relation of the lumbar sympathetic trunk to the bodies of the vertebra. This shows the retraction of the third portion of the duodenum necessary to expose the second lumbar ganglion.

milligrams, uric acid 4.24 milligrams, creatinine 1.5 milligrams, and sugar 0.11 per cent. The blood and urine examinations were normal.

**Operation.** On January 29, 1926 a right cervical sympathectomy was performed. Since we were anxious to leave no possible sympathetic innervation to the upper extremity from the cervical chain we removed the entire chain and all of the ganglia from the superior to the stellate inclusive. Naturally all of the rami of the latter were severed. Again we will simply remove the stellate ganglion because we feel that this structure contains all of the cells of origin of fibers innervating the upper extremity.

**Postoperative course.** The patient made an uneventful recovery from her operation. No sensory findings were present about the face or neck. We may state here that in none of our cases have we

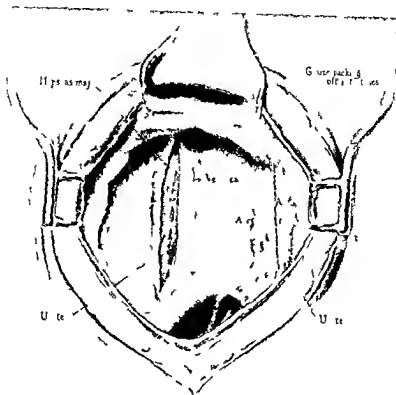


FIG. 5. Incision through the posterior peritoneal wall over the medial edge of the psoas muscle.

#### *Raynaud's Disease—Right Cervical Sympathectomy—Relief*

E. W., aged 28, a Polish housewife first noted in 1918 that the middle finger on her right hand would become pale and blue in color when she was out in the cold weather or when she had her hands in cold water. This color change was always accompanied by severe pain and numbness and tingling in the finger. During the following 6 years these symptoms gradually progressed to involve the other fingers and the thumb of the right hand. The patient then noticed that excitement or worry would produce the same symptoms and under such conditions her face would become deeply flushed. In 1924 this same group of symptoms appeared in the fingers of the left hand. The pain in her hands had been very severe and she had sought relief in many ways without success.

The patient also stated that she very commonly had ulcerated areas on the ends of her fingers which followed the slightest trauma. The healing of these

lesions was always followed by retracted scars. During the past year the patient had been complaining of pain in the toes of both feet accompanied by a slight bluish discoloration. The past history was without note and no relation could be drawn with her present condition.

**Examination.** The patient's face is of a dark red dish purple color particularly when she is under observation. Her skin is naturally dark in color. There is a bilateral exophthalmos. The thyroid gland is palpable but not abnormally enlarged. There are no bruits or thrills over it. Blood pressure is 120/68, pulse 88.

By placing the hands in cold water or by surprising the patient an attack of discoloration of the fingers can be produced. Normally the hands are perhaps slightly redder in color than those of the average individual. During an attack the color rapidly changes to a bluish gray. This involves all of the fingers and thumb down to the metacarpophalangeal joints except the fifth fingers which

we refrain from including a detailed history of her case

*Thrombo Anguitis Obliterans—Lumbar Sympathectomy—No Relief* Observation of a Second Case after *Periarterial Sympathectomy Elsewhere—No Relief*

We also wish to record our experience with sympathectomy in this disease and because of the clinical failure we refrain from giving a detailed report

We removed the right lumbar sympathetic trunk and ganglia from a patient whom we believed had an erythromelalgia. The red color of this man's extremities was intensified in the dependent position but a fact to which we did not give sufficient weight was that this color was not paroxysmal but was constantly present. He had a trophic ulcer upon the end of his great toe on the right foot and all but his dorsalis pedis vessels pulsated. X-ray plates of the extremity failed to show any calcification in the vessels. The pain persisted as did the color changes in the foot and after 3 months no improvement whatever was evident. Because of the intense pain which persisted and because of an advancing gangrene an amputation was performed. Examination of the vessels showed the organic changes of a thrombo anguitis obliterans.

We have observed a second example of this disease which was verified by an examination following amputation of the extremity. A periarterial sympathectomy had been performed elsewhere 9 months previously. The patient complained bitterly of pain in his foot and required morphine for relief. The color changes in his toes and foot were typical of those seen in the preceding case. However no gangrene had developed although no pulsation could be felt in any of the peripheral vessels.

We made a diagnostic error in the first of these cases of thrombo anguitis obliterans. Recognition of the lesion and a thorough understanding of the organic changes in the vessel wall are sufficient contra indications to an operation designed to attack the sympathetic innervation of an extremity. One cannot hope to dilate or constrict an arterial wall so altered by a pathological process such as Buerger's so carefully described in this disease.

#### DISCUSSION

In discussing the physiological effect of removal of the sympathetic innervation to an extremity one is prone to go beyond the few known facts in order to furnish a plausible and logical explanation.

First of all we know that arterial decortication or removal of the sympathetic chain produces hyperemia and increased temperature in the corresponding extremity in man. Sec

ond the symptoms of paralysis of the vasoconstrictors or unfettered influence of the vasodilators gradually disappear within from 1 to 2 weeks after the operation. Third the sympathetic innervation to the blood vessels of an extremity is furnished at segmental intervals by way of the spinal nerves. Fourth that any fibers of sympathetic origin within the blood vessel wall are not continuous along the wall of that vessel. Fifth in certain vascular diseases of the extremities characterized by paroxysmal vasomotor symptoms and the absence of organic vessel pathology removal of the sympathetic chain is followed by an improvement in symptoms. Finally we must bear in mind the fact that there are many variable factors concerned in the control of the peripheral circulation of which the vessel musculature and caliber are but a part.

The known anatomical and physiological facts concerning the origin, distribution and supply of the sympathetic fibers to the extremities explain the results obtained upon interrupting such an innervation at its origin or in its course. Thus removal of the sympathetic chain or severance of the somatic nerve supply produces definite physiological effects in the corresponding extremity. Such procedures and results are logical and in the event of interruption of the sympathetic chain are the result of removal of the active vasoconstrictor mechanism. Since the sympathetic innervation to the vessels of an extremity is supplied in a segmental manner *a priori* the removal of a small portion of the terminations of these sympathetic fibers could not be expected to affect permanently any portion of the vessel except the local segment operated upon. On the other hand both local and distant favorable effects in the extremity after cortical decortication are reported. The effect of such a procedure upon the vessel caliber at the site of operation might very well be explained upon the basis of the interruption of a local short reflex mechanism within the wall of the vessel. Our knowledge makes it impossible to explain accurately the hyperemia produced in the foot by removal of the adventitia upon a small segment of the femoral artery.

While it would seem more logical to remove

found any subjective or objective sensory disturbances in the face or neck following a sympathectomy. There is an enophthalmos, small pupil, narrow palpebral fissure and the scleral vessels are dilated upon the right side. It will be remembered that the patient had an indolent ulcer on the index finger of her right hand when she came into the hospital. We removed the dressing and simply allowed the finger to be exposed without in any way treating the lesion.

February 4, 1926. The patient has had no pain and no attacks of local syncope and asphyxia since her operation. The right index finger is entirely healed and the skin of the tip of the finger is pink. The right upper extremity has been from one to two degrees warmer than the left since her operation. The patient states that the examiner's hands are colder when felt with her right hand as compared with her left. No difference in the color of the fingers or hands can be detected except during an attack.

February 7, 1926. The temperature difference is less today as measured with a surface thermometer. The patient's hands were immersed in ice cold water today. After 15 minutes no change had occurred in either hand. As soon as they were brought into the air the attack of syncope and asphyxia began. The change in color to the typical chalky bluish white blanching occurred quickly in both hands. However the extent of the color change and the degree of change were quite different in the right hand. The ends of the thumb and fingers except the right fifth finger were involved only over the middle and distal phalanges as contrasted to the condition in the left hand in which the changes extended into the palm of the hand. Further the return to the normal color of the right hand was completed 5 minutes before that in the left.

March 4, 1926. The patient was taken to the artist for a colored sketch of her hands. Before entering the presence of this stranger her hands were normal in color. Immediately upon meeting him she began to develop an attack of local syncope and asphyxia. The result of this attack which lasted 30 minutes is seen in Plate I. She returned upon several occasions in order that this color might be verified and it was not until the third visit that the change did not occur and cold water immersion was necessary.

March 27, 1926. The patient notes a great difference in the condition of her right hand. She has had no paresthesia or pain and her hand never feels as cold as the left nor as it did previously. The lesion of the right index finger has never recurred. The Horner's syndrome on the right side has remained unchanged.

April 6, 1926. The patient has had no pain in her right hand. During an attack the middle finger of the right hand becomes cyanotic from the tip to the proximal interphalangeal joint while the rest of the fingers and hand are normal in color. The left hand becomes markedly blue and painful. There has been a decided improvement since the time represented in Plate I.

The occurrence of induration in the tips of this patient's fingers suggests of course scleroderma. Since vasomotor changes may be early manifestations of scleroderma this condition may be difficult to differentiate from Raynaud's disease. Buerger quotes Cassiner as grouping Raynaud's disease into three types. The typical cases show symmetrical gangrene dystrophic changes in the distal portions of the extremities with thickening of the skin and immobilization of the tendon sheaths and joints. The second group comprises the cases in which local asphyxia and syncope initiate the disease. There is no progression into a state of gangrene but on the other hand a chronic stage of vasomotor sensory and sclerodermic symptoms occurs. The last group consists of rare cases which show vasomotor symptoms in the presence of an advanced scleroderma. Our case obviously belongs to the second group. Certainly it belongs to the group of vasomotor neuroses of which the Raynaud syndrome is an example. Buerger (3) believes that in these cases there is an irritative or perhaps a paralytic process in the vasomotor system. Cassiner believes that the vasoconstrictors are in a condition of increased irritability.

Adson and Brown (1) have reported a case of Raynaud's disease in which they removed the lumbar sympathetic chain and stripped the adventitia from the external iliac vessel upon the same side. They have reported a marked improvement in the extremity upon the side operated upon. They believe that such a double procedure prolongs the physiological effects of removal of the sympathetic innervation.

While time has not elapsed following the operation equal to that in the first instance we feel that this patient has received definite improvement and relief.

We have operated upon another patient with Raynaud's disease and removed the stellate ganglion upon the right side. The patient suffered from local syncope and asphyxia in all four extremities but the symptoms were more advanced in the hand. Thickening of the skin and immobilization of the tendon sheath and joints of the hands were present. The patient was operated upon so recently that we have had no opportunity to determine accurately just what her postoperative status is. Consequently

## RECENT DEVELOPMENTS IN PERORAL ENDOSCOPY

CESOPHAGOSCOPY AND BRONCHOSCOPY FOR DISEASE, REPORT OF CASES<sup>1</sup>

BY C. ABRIEL TUCKER M.D. PHILADELPHIA

Associate Professor of Diseases of the Esophagus and Bronchi, School of Medicine, University of Pennsylvania, Philadelphia, Pa.

**B**RONCHOSCOPY and cesophagoscopy originally concerned chiefly in the removal of foreign bodies have become most useful in the diagnosis and treatment of disease by bringing under direct inspection of the eye formerly invisible regions of the air and food passages. The following reports of cases illustrate different phases of the development of peroral endoscopy.

## POSTOPERATIVE MASSIVE COLLAPSE OF THE LUNG

In recording the observations from the bronchoscopic examination of 2 cases of postoperative massive collapse of the lung nothing new is offered as to etiology. The literature has been recently reviewed and the subject very ably considered by a number of observers among them Dr. Walter Estell Lee (2) of The Pennsylvania Hospital of Philadelphia, Dr. Edward D. Churchill (1) of the Massachusetts General Hospital Boston and Dr. Simon Leopold (3) of the University of Pennsylvania Hospital Philadelphia. Of the 2 cases here reported the first occurred in a boy aged 13 years on the service of Dr. Walter Estell Lee at the Germantown Hospital Philadelphia. This is believed to be the first case of postoperative massive collapse to be examined bronchoscopically. The examination was made January 14, 1925. That bronchoscopic study might possibly throw considerable light on the mechanism of postoperative pulmonary collapse had been suggested by Chevalier Jackson to Dr. Simon Leopold who recorded this suggestion in his paper on the subject of postoperative massive collapse but opportunity for bronchoscopic study had not presented itself until at Dr. Lee's request a bronchoscopy was done for this condition.

**CASE 1.** A boy 13 years of age had been in good health until he developed acute appendicitis with

abscess. He was admitted to Dr. Lee's service at the Germantown Hospital. The abscess was drained under ether anesthesia the procedure requiring only a few minutes. Thirty-six hours after the operation he became acutely ill with symptoms of shock. Physical examination showed the signs of collapse of the right lung. X-ray examination confirmed these findings (Fig. 1 a). There was the typical displacement of the heart toward the affected side with evidence of increase of density of the affected right lung. The patient reacted from the acute symptoms and 48 hours after the onset of the collapse bronchoscopy was done. There had been expectoration of the typical tenacious sputum slightly greenish grey in color which when expectorated into a cup stood up from the bottom of the cup like gumdrops. Bronchoscopy revealed the tracheal mucosa reddened and glistening with greyish secretion adherent to the tracheal wall. The inflammatory condition became more marked in the lower trachea and right bronchus. The left bronchus was clear of secretion the mucosa being only slightly inflammatory. The orifice of the right main bronchus was completely surrounded by a thick ring of tenacious secretion. The orifice of the right upper lobe bronchus was not completely blocked but patches of secretion were adherent to the wall of the bronchus. The stem bronchus and the middle and lower lobe bronchi were completely blocked with the thick secretion. The mucosa was very red and thickened. The secretion was aspirated from the larger bronchi.

It was noted that the right main bronchus deviated toward the right there was no evidence of bronchial compression. There seemed to be marked restriction of the bronchial movements. Inspiratory opening and lengthening of the bronchus was very slight particularly in the lower and middle lobe bronchi. Bronchoscopic diagnosis was diffuse bronchitis involving the right main bronchus and its branches most marked in the lower stem and middle lobe bronchi. bronchial obstruction of the middle and lower lobes with thick tenacious secretion. Swab specimen of secretion showed pure culture of pneumococci.

Physical examination immediately following bronchoscopy showed evidence of air entering the right lung. The heart showed less displacement to the right (Fig. 1 b). Within 24 hours the collapse had recurred. At the end of 48 hours the right lung had begun to clear the character of the sputum had changed being mucopurulent thin and less tenacious. Bronchoscopy was repeated at the end of the third day and showed the inflammatory con-

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Chicago Meeting of the American Academy of Ophthalmology and Otolaryngology, October 9, 1925.



the sympathetic ganglia and rami rather than to decorticate an artery, we are still met with the inability to explain completely our results in cases of vascular disease of the extremities. Primarily we do not know the underlying pathology in these cases of vascular disease which would appear to be benefited by removal of the sympathetic innervation. It is assumed that those diseases in which no organic vessel pathology can be demonstrated are the result of a vasomotor neurosis and that the sympathetic innervation to the extremity is at fault. There are no facts to support such a contention except the empirical observation that removal of the sympathetic innervation effects an improvement. In view of the many circulatory factors previously pointed out which may have an important relation to these diseases we cannot convince ourselves that an alteration in one of the peripheral mechanisms may be the sole key to the situation. This doubt is somewhat strengthened by the observation that the physiological results of interruption of the sympathetic innervation gradually become less pronounced and finally disappear. There is abundant experimental support for this clinical observation. Just what the actual mechanism of this readjustment is we are at present unable to say.

### CONCLUSIONS

1 The peripheral blood vessels receive their sympathetic innervation in a segmental manner by way of the somatic nerves.

2 Removal of the sympathetic innervation to an extremity in man is followed by hyperæmia and hyperthermia which gradually disappear within one to two weeks following operation.

3 In certain vascular diseases of the extremities characterized by paroxysmal vasomotor symptoms and the absence of organic vessel pathology removal of the sympathetic

innervation is followed by an improvement in symptoms. Among this group we may include erythromelalgia and Raynaud's disease.

4 There are many physiological factors concerned in the control of the peripheral circulation of which the vessel musculature and caliber are but a part.

5 In the present state of our knowledge concerning the pathology of the group of vascular diseases known as vasomotor neuroses we are unable to explain completely the effects produced by removal of the sympathetic innervation to the extremity.

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Fig 1 a



Fig 1 b



Fig 2

Fig 1 a. Boy aged 13 years patient of Dr Walter Estell Lee developed massive atelectasis of the lower and middle lobes of the right lung 36 hours after drainage of an appendiceal abscess ether anesthesia. Roentgenogram 48 hours after onset of collapse before bronchoscopy. Note density of the affected side with displacement of heart and mediastinum toward the affected side. Compare with Figure 1 b.

Fig 1 b. Roentgenogram 10 minutes after bronchoscopy. Air has entered the area of lung that showed

collapse. The heart has moved back nearly to the normal position. The tenacious secretion were aspirated from all the larger bronchi.

Fig 2. Roentgenogram (same case as that in Figure 1) 72 hours after the first bronchoscopy. Lung has cleared up almost entirely. Heart has gone back to normal position. Bronchoscopy at this time showed the character of the secretion had changed. There remained a purulent bronchitis but there was no blocking of the bronchus. The air passed in and out of the lower lobes without obstruction.

distention of the trachea and right bronchus to be less severe than at the previous examination. A small amount of secretion slightly purulent in character was aspirated from the right main bronchus. The left bronchus was free of secretion. The right bronchus showed no abnormal deviation. The bronchial movements seemed normal. The secretion in the middle and lower lobe bronchi was thin and was aspirated without difficulty. The bronchoscopic findings indicated that there was a much greater degree of secretion of the lower and middle lobes than at the first bronchoscopy. Previous to this bronchoscopic examination the heart had gone back to practically the normal position and the physical signs indicated that there was good aeration of the right lung (Fig. 1). The recovery of the patient was uneventful following the second bronchoscopy. It was noted by Dr Lee (2) that the collapsed lung cleared within 7 hours after the first bronchoscopy while in the other cases of his series in which bronchoscopic treatment had not been carried out the recovery had extended over an average period of 21 days.

CASE 2. The second case occurred on the service of The Chevalier Jackson Clinic at the Jefferson Hospital. A boy 6 years of age had been operated on for the closure of a gastrosomatic fistula that had been made for the purpose of retrograde treatment of cicatricial stricture of the esophagus. The stricture of the esophagus was cured and the gastrosomatic opening had been closed. Ether anesthesia was used during the operation. The patient coughed

a great deal and was troubled with considerable secretion during the anesthesia. Thirty-six hours after the operation pulmonary symptoms developed and by the end of 48 hours the typical signs of postoperative massive collapse of the left lung were present. Seventy-two hours after the operation bronchoscopy was done July 13, 1926. Very thick tenacious secretion whitish yellow in color was found in the trachea and left bronchus. The mucosa of the bronchus was very inflammatory. Following aspiration air seemed to enter the left lung. Ten cubic centimeters of the thick whitish yellow exudate were aspirated and a culture of the removed secretion showed pneumococci and staphylococci. Dr Manges' report on the roentgenogram (Fig. 3) June 13, 1925 reads: "There is complete collapse of the left lung. Trachea and heart are drawn all to the left. It is impossible to see the shadow or outline of the heart or left diaphragm. The lung shadow is equal in density to that of the heart so that there is no detail at all seen in the left chest." Film made 1 1/2 hours after bronchoscopy shows: "The lungs contain a considerable quantity of air. The trachea is near the median line. The right border of the heart is even with the right border of the spine shadow and the outline of the diaphragm as well as the left border of the heart is clearly seen. There is evidence of function because there is more air in the left lung at expiration than there is at expiration (Fig. 4 a b). This indicates definitely that some obstruction was removed from the left lung at the time of bron-



Fig 3

Fig 4 a

Fig 4 b

Fig 3 Postoperative massive collapse of the entire left lung common on 72 hours after abdominal operation under ether anesthesia.

Fig 4 a Roentgenogram on expiration 1 hour after bronchoscopic aspiration shows decided clearing of the left lung. Compare with Figure 4 b.

Fig 4 b Roentgenogram taken at inspiration. Comparison of the roentgenograms a and b shows more air in the left lung during inspiration indicating that there has been return of function following the bronchoscopic aspiration. The roentgenograms in this case were made by Dr. Mange.

choscopy. The lung showed evidence of collapse again in 4 hours after the first bronchoscopy. The X ray examination gave the same findings as before bronchoscopy. Bronchoscopy was again performed and 14 cubic centimeters of thick yellowish secretion were aspirated (Fig 5). X ray examination again showed return of function in the lung. Three days later the collapse had recurred and another bronchoscopy was performed. The secretion was less in amount and less tenacious in character. The secretion of the left lung remained improved for a considerably longer period but there was still evidence of considerable secretion in the chest and one week later bronchoscopy was again performed and 4 cubic centimeters of the thick tenacious material were aspirated from the left lung principally from the lower lobe bronchus. Two subsequent bronchoscopies were done after intervals of 2 and 5 days respectively and following this the patient was able to keep the lung free of secretion. The cough reflex seemed to have returned and his improvement was progressive and he was discharged from the hospital well 6 weeks following the onset of the postoperative massive collapse. In all 6 bronchoscopies were done during a period of 20 days.

In the second case the secretion was more purulent in character than in Case 1 which can probably be accounted for by the presence of the staphylococci. The patient also seemed more toxic and was very much less able to cough up the thick secretion.

We have demonstrated bronchoscopically that bronchial obstruction exists. The tenacious mucus which Pasteur and practically all other observers state is coughed up in all

cases acts as a foreign body. Whether this tenacious secretion is produced by the collapse of the lung squeezing the secretion into the bronchi or whether its presence there causes collapse of the lung due to the absorption of the air in the portion of the lung obstructed does not influence the fact that it is necessary to remove the obstruction by aspiration by absorption or by liquefaction and coughing it up. In some manner it must be removed so that air can enter before the lung can possibly expand.



Fig 5 Photograph of inverted test tube containing the secretion aspirated from the lung in postoperative massive collapse. The thick gelatinous secretion remains at the bottom of the inverted tube.



Fig 6 a (left) Massive atelectasis of the entire right lung 48 hours after the lodgment of a bean in the right main bronchus. Compare with figures 1 a and 3 roentgenograms of postoperative massive collapse.

Fig 6 b Roentgenogram 24 hours after the bronchoscopic removal of the bean showing the lung has expanded to normal and the heart gone back to normal position on roentgenogram by Dr Pancoast.

Dr Manges has proved by roentgen ray examination that function is restored following bronchoscopic removal of the obstructing secretion and we have been able to demonstrate by repeated bronchoscopies in the second case that the tenacious secretion blocks the bronchus when collapse is present. Bronchoscopy after the collapse has disappeared shows purulent secretion present but not obstructive in character or quantity.

We have seen massive obstructive atelectasis in many cases when the bronchus was blocked by foreign body. The foreign body that is the most effective in producing atelectasis is the dried bean (Fig 6 a and b). This object because of its shape when lodged in the bronchus blocks the passage of air and the action of warmth and moisture in the bronchus produces a rapid increase in the size of the bean, corking the bronchus completely. Atelectasis is very quickly and effectively produced. The physical signs and X-ray findings are the same as those in postoperative massive collapse. The removal of the bean uncorks the lung and it rapidly expands and in a few hours returns to normal. The obstruction is completely removed. In the cases of massive collapse when the secretion

has been removed bronchoscopically partial function is restored immediately but it is not possible to aspirate all of the secretion from the finer bronchioles. The secretion reaccumulates in the larger bronchi and the collapse recurs due to the complete plugging of the bronchi. The indication is clear for early bronchoscopic aspiration of secretion. The procedure is carried out with local anesthesia in adults and no anesthesia in children. The question as to what patient should be subjected to aspiration is one for the surgeon who has knowledge of the operative condition to decide.

When reaccumulation occurs repeated aspiration should be carried out until the weakened respiratory force revives, the cough reflex returns and the lung is able to rid itself of the obstruction or in other words until the vicious circle of obstruction atelectasis atelectasis obstruction is eliminated.

#### POST TONSILLECTOMY AND POSTOPERATIVE PULMONARY ABSCESS

Post tonsillectomy and postoperative pulmonary abscess are now recognized as being of much more frequent occurrence than was formerly believed. The supposed catching

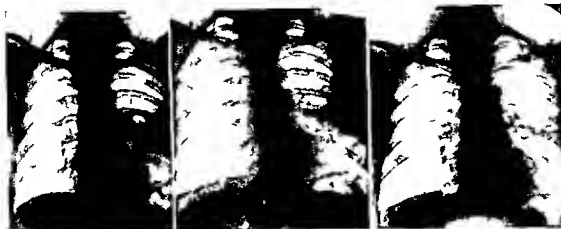


Fig 7

Fig 8 a

Fig 8 b

Fig 7 Post tonsillectomy abscess. Roentgenogram of a man 40 years of age showing a pulmonary abscess in the left lower lobe with pleural involvement. Bronchial symptoms came on 4 days after tonsillectomy. Film was made 3 months later on his admission to the clinic. This was thought to be a case for external drainage but the pleural involvement cleared rapidly and in consultation with the surgeon it was decided that bronchoscopic treatment be carried out. This was done at weekly intervals. See Figure 8.

Fig 8 a and b Post tonsillectomy abscess. These roentgenograms show a progressive decrease in the area of the lung involved. The man gained 25 pounds in weight while under bronchoscopic treatment. Roentgenograms made at the end of 3 months show the lung almost clear. Report at the end of 6 months from the referring physician, Dr. Robert D. Spencer, states that the patient is well and roentgen ray examination is negative for evidence of the former lung abscess.

cold following tonsillectomy or other operative procedures is now recognized as a direct complication following the operation. As to the mode of infection, some cases are undoubtedly due to aspiration of infective material at the time of operation. This is proven by the aspiration of deciduous teeth

which have been dislodged at the time of the tonsil operation and inspired into the lung with resultant abscess. Recently the author removed bronchoscopically from the left bronchus of a patient a tonsil sponge that had been aspirated during the course of a local tonsillectomy.

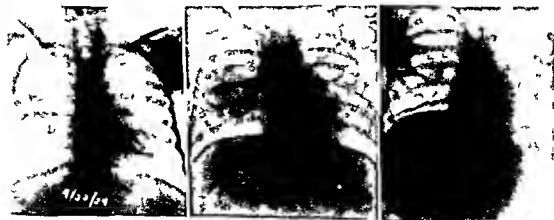


Fig 9 a

Fig 9 b

Fig 9 c

Fig 9. Post tonsillectomy abscess. Roentgenogram of a child 1 1/2 years of age. Pulmonary symptoms developed 1 week following tonsillectomy. Films made 2 weeks after tonsillectomy show a decrease in the hematologic lobe.

Fig 9 b and c. Films made 2 days later showing marked extension of the pathological process. Bronchoscopy was done a piration carried out. Following, this the child evacuated large quantities of pus. Figure 9 c.



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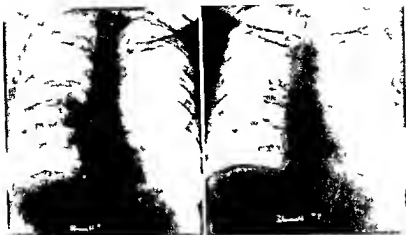


Fig 11 a (left) Postoperative pulmonary abscess Patient 30 years of age Roentgenogram made 5 weeks after the onset of symptoms showing marked evidence of a pathological process in the right lower and middle lobes Bronchoscopic treatment was begun at this time Seven bronchoscopies were done at intervals of 1 week Fig 11 b Roentgenogram made 6 months after bronchoscopic cure Patient had gained 40 pounds in weight and was symptomatically well Films by Dr Pancoast

completely There is now no expectoration and the patient has been discharged well In this patient there was a contra indication to bronchoscopy when he was admitted because of the pleural involvement and it was felt advisable to consider external drainage On the improvement of the pleural complication the contra indication was removed and when the patient ceased to improve bronchoscopic treatment was instituted and rapid cure resulted

CASE 2 A boy 7 years of age was referred to the Clinic 7 weeks following tonsillectomy The operation had been performed under ether anesthesia In the first week following the operation the child developed a cough and had pulmonary symptoms up to the time of admission He had lost weight and there had been an afternoon rise of temperature to 101.4 degrees F A roentgen ray examination by Dr W F Manges 3 days prior to admission showed an abscess in the lower portion of the right upper lobe X ray examination the day following admission showed an increase in the area of involvement Physical examination also indicated that there was an extension of the pathological process Diagnostic bronchoscopy was done and evidence of a suppurative process was found in the right upper lobe A swab culture taken showed a practically pure culture of pneumococci There had been no expectoration prior to bronchoscopy but following bronchoscopy there was considerable cough and expectoration of very foul pus The child's general condition showed improvement immediately Two days later a second bronchoscopy was done and a considerable quantity of very foul pus was aspirated from the right main and upper lobe bronchus The pus was found to be coming entirely from the right upper lobe bronchus Roentgen ray

examination following bronchoscopy showed marked improvement (Fig 9 a b c) The abscess had been evacuated The area of involvement in the right upper lobe showed a cavity 1 inch in diameter that was free of fluid The patient's temperature came down to normal and remained there Roentgen ray examination 4 days later was reported by Dr Manges as showing a distinct diminution in the area involved The improvement was progressive At the end of a week another X ray examination was made and Dr Manges reported definite improvement and a clearing up of the inflammatory area (Fig 10 a and b) The patient was discharged from the hospital and his improvement continued to complete recovery

CASE 3 A male aged 30 years a former enlisted man in the British Navy was injured by the blowing off of the top of a pneumatic paint spraying machine that he was using the top striking him on the neck jaw and right chest He had a fracture of the lower jaw in two places and a number of teeth were dislodged He was operated upon 5 weeks after the injury under local anesthesia A portion of the lower jaw was removed and several teeth were extracted Four weeks later a second operation was done and additional teeth were removed with a second piece of the lower jaw the procedure being done under gas and ether anesthesia Two days later he developed a severe pain in his chest and 5 days following the operation he began to expectorate blood stained pus The productive cough and septic temperature range continued during the next 3 weeks X ray examination prior to admission showed a pulmonary abscess in the right lower and middle lobe (Fig 5 a) He was referred to the Clinic by Dr John S Eynon of Chester Pennsylvania





Fig 10 a and b Post tonsillectomy abscess. Films taken at interval of 1 week showing progress in clearing following the two bronchoscopic treatments. Child completely recovered.

If foreign material of this type can be aspirated it is reasonable to conclude that infective material can be aspirated in the same manner that would result in abscess formation. The infection may also occur through the blood stream as has been proven by the work of Fetterolf and Fox and other observers. It would seem that bronchoscopic aspiration would be most effective in the cases in which the abscess is due to inspiration of infective material. We have not however been able to prove this in the bronchoscopic treatment of post tonsillectomy pulmonary abscess. The results of bronchoscopic treatment in many cases have been very encouraging in a few cases bronchoscopic aspiration has resulted in prompt cure. Our experience has led us to believe that the sooner the bronchoscopy is done particularly in cases due to aspirated infection the more promptly the beneficial results are obtained. Three cases are reported here in which bronchoscopic treatment undoubtedly contributed very greatly to the cure.

**CASE 1.** A male aged 40 had a tonsillectomy 5 months before admission to the Clinic. Pulmonary symptoms commenced 4 days following tonsillectomy. At the end of the first week there were elevation of temperature and cough with expectoration of foul sputum and it was thought that he had caught cold following tonsillectomy. He did not improve

under medical treatment and at the end of 4 months he consulted Dr Robert D Spencer of Ashland, Pennsylvania who after X-ray studies and bronchoscopic examination diagnosed the condition as pulmonary abscess involving the lower lobe of the left lung. When the patient came to the Clinic it was found that there was a pyramidal area in the left lower lobe that extended outward from the hilus of the lung toward the pleura with the base outward (Fig 7) and physical examination showed there was pleural involvement. The surgical consultant advised observation of the patient and if the condition should not improve he felt that external drainage would be the proper procedure. At the end of a week the pleural signs had cleared to some extent. X-ray examination showed there was a decided decrease in the involved area in the left lower lobe particularly had there been a clearing up of the peripheral area of the lower lobe. The patient was kept under observation and improvement continued. At the end of 4 weeks he developed a fever 101 degrees F and complained of sore throat. Examination at that time showed that he had an acute infection of the upper respiratory tract. Following this the amount of expectoration increased but the area of involvement in the lung while larger seemed to have cleared up at the periphery at the point of pleural involvement. In consultation it was decided that bronchoscopic drainage should be done. This was carried out at semi weekly intervals and after 8 bronchoscopies there was no sputum being expectorated the man had gained 25 pounds in weight and repeated roentgen ray examinations showed a progressive decrease in the area of lung involved (Fig 8 a and b). At the end of 2 months following the beginning of bronchoscopic treatment the lung had cleared up



Fig 13. Bronchoscopic aid to tracheotomy. Roentgenogram showing large mediastinal tumor compressing the trachea and left bronchus and leaving a narrow lumen into the right bronchus. Bronchoscope was inserted down to the right bronchus. Trachea incised with the bronchoscope in position. Tracheostomy tube introduced into the right bronchus on withdrawal of the bronchoscope.

and had a massive enlargement of the thyroid gland malignant in character which covered the larynx and extended downward to the upper thoracic aperture bulging outward above the suprasternal notch (Fig 12). Mirror examination showed a bilateral recurrent paralysis although the dyspnea was both inspiratory and expiratory. The question of tracheotomy had been considered and it was thought impracticable because of the enormous size of the thyroid and the resultant tracheal compression and displacement. It was felt that the only

possible way to perform a tracheotomy was to insert a bronchoscope and maintain the airway while the trachea was being found. On insertion of the bronchoscope through the paralyzed larynx it was found that a fungating ulcerating mass projected into the tracheal lumen at the level of the suprasternal notch. We were able to insert a 6 millimeter bronchoscope through the narrowed tracheal lumen. The incision was then made through the enlarged thyroid and it was found that the trachea was displaced beneath the border of the left sternomastoid muscle.



Fig 14 (left). Bronchoscopic aid to the evacuation of a retropharyngo-cervical abscess. Roentgenogram of a boy 9 years of age showing an enormous retropharyngo-cervical abscess flowing, a puncture wound through the trachea and oesophagus by a sharp point of glass.

Bronchoscope was inserted through the larynx in order to prevent a protrusion of pus. Abscess was evacuated from the hypopharynx.

Fig 15. Showing the same region in the neck after complete cure of the abscess.



Fig. 12 a (left) Bronchoscopic aid to tracheotomy. Cancer of the thyroid gland involving the trachea. Bronchoscope was introduced below the cancerous involvement of the trachea the neck opened in the front a No. 5 tracheotomic cannula inserted as the bronchoscope was withdrawn.

Fig. 12 b Showing the tracheotomy tube in position.

for bronchoscopic treatment. Roentgen ray examination revealed no evidence of foreign body. Bronchoscopic examination showed very foul blood stained pus in the bronchus and trachea. After aspiration it was found to reappear from both the lower and middle lobes. The mucosa of the right lower and middle lobe bronchi was very inflammatory. Pus was aspirated and local medication applied. No foreign body was seen on bronchoscopic examination. The surgical consultant advised that bronchoscopic aspiration be carried out. The patient's blood Wassermann was negative. The culture from the swab specimen taken at the first bronchoscopy showed *streptococcus mitis* (non hemolytic) to be the predominating organism. Vaccine was made from this culture and administered by the medical consultant. Bronchoscopy was repeated at weekly interval. Pus aspirated and local medication applied. The patient's condition improved progressively and after 5 bronchoscopies the inflammatory condition of the middle and lower lobe bronchi had almost entirely disappeared. The pus had lost its odor and had become thin in consistency and whitish in color. The man's general condition had improved markedly and he insisted on getting up around the ward his temperature having been normal for a period of 2 weeks. He was allowed to go home and return as an out patient for treatment. X ray examination at this time showed marked diminution of area of involvement in the right lung. Bronchoscopies were carried out at weekly intervals and at the seventh the third after he left the Hospital the bronchus was found practically normal and the

tracheobronchial tree free of pus. The man had gained 25 pounds in weight and X ray examination at this time showed progressive improvement. Bronchoscopy was discontinued 2 months later and the patient returned at the end of another 2 months for observation. He was found to be in excellent physical condition. His weight on admission had been 105 pounds and at the time of his return it had increased to 135 pounds. X ray examination showed the right chest practically normal (Fig. 12 b).

The patient presented an unusual complication because of the fracture of the lower jaw. It was found possible to expose the larynx by working from the left side of the man's mouth instead of the right as is the usual route without discomfort or interference with the injured lower jaw and in this manner the treatments were carried out.

This demonstrates that bronchoscopy can be done as Jackson states in any patient whose mouth can be opened widely enough to admit a bronchoscope.

#### BRONCHOSCOPIC AID TO TRACHEOTOMY

There are certain pathological conditions in which there is tracheal compression and displacement of the trachea in which bronchoscopic aid in maintaining the airway and finding the trachea for insertion of the tracheotomic cannula is invaluable.

CASE 1. A man aged 65 was seen in consultation with Dr. Frank Bridgett. He was very dyspneic

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In this discussion of diabetic and arteriosclerotic gangrene of the lower extremities we have included 100 cases. Though more cases were available, only those were chosen that were complete and from which reliable data could be obtained. The analysis has been made with the view of presenting various facts regarding so called diabetic gangrene, with the hope that by a better knowledge of gangrene in diabetics and arteriosclerotics a keener interest and regard will be awakened in the profession that will bring about a greater saving of the extremities and lives of those unfortunate victims of the trepidation and procrastination on the part of both themselves and their advisers.

In the preface to his new edition, Joslin aptly remarks "Surgery is entirely rewritten because diabetes is so often a surgical problem more than one fifth of all Boston diabetics dying of gangrene."

## PATHOLOGY

The more cases of gangrene in diabetes that one sees the more one is impressed with the fact that it is analogous to senile or arteriosclerotic gangrene with the added local and general disturbances of metabolism that occur in diabetes.

Arteriosclerotic gangrene (21) is the result of obliterating endarteritis and occurs in the very old in whom the heart is generally feeble and the kidneys diseased thus contributing to the impairment of nutrition. The arteries become calcareous and inelastic and much reduced in caliber. The actual onset of gangrene is often determined by a slight injury or inflammation which induces thrombosis in smaller vessels or a thrombus may form in the main artery supplying the limb.

It is not held that arteriosclerosis is the cause of diabetes but that it is a contributing cause in the occurrence of diabetic gangrene for as Joslin (10) points out, "arteriosclerosis

is of common occurrence in protracted cases of diabetes. It seldom occurs even in the severest cases of diabetes in youth and not frequently before the age of 50 years—a strong argument against diabetes being a direct causative factor of arteriosclerosis. The comparative rarity of diabetic gangrene under the age of 60 years is also evidence in the same direction.

That the local manifestation of gangrene in diabetic extremities is due to a disturbed local circulation is shown by the careful studies of Buerger (1) who states that a study of the condition of the arteries and veins in limbs amputated for so called diabetic gangrene reveals the fact that in each and every instance we are dealing not with a gangrenous process due to the diabetes per se but with a mortifying process dependent upon extensive arterial disease. In short characteristic of so called diabetic gangrene is the presence of the typical lesions of arteriosclerosis that differ in no way from the lesions of the arteries of the arteriosclerotic or senile gangrene and that justify the conclusion that in diabetic gangrene we are dealing with an arteriosclerotic process.

Joslin (10) adds that if one needs to be convinced of the uselessness of attempting to save most gangrenous legs the specimens removed at operation should be studied. These show how hopeless it is to expect the arteries to regain their function. Regret is felt not for the removal of the leg at the time but rather that it had not been removed earlier. Extensive thrombosis of a leg precludes healing.

Under the caption Arteriosclerotic Gangrene with Diabetes Buerger (2) writes that such gangrene usually eventuates after traumatism thermal or mechanical. The narrowing and rigidity of the arteries coupled with the presence of the metabolic deficiencies due to the diabetes are sufficient to lead to gangrene of the tissues upon the mere action

The carcinomatous thyroid had so involved the trachea that its walls could not be distinguished. In order to find the trachea the bronchoscope was with drawn partially the lights in the room lowered and the trachea found by transillumination. An incision was made in the trachea and a cane shaped Jackson's tracheotomy cannula inserted passing below the level of the malignant involvement of the trachea.

**CASE 2** A young man 19 years of age was referred from the medical service of Dr. Stengel of the University Hospital with marked dyspnea. The diagnosis was of lymphosarcoma of the mediastinum. The case was not considered as amenable to surgery and before X ray treatment was carried out it was advised that tracheotomy should be done. A lateral X ray examination by Dr. Jancoast showed a large mediastinal tumor producing marked obstruction of the trachea. The mass extended upward from the anterior mediastinum into the neck to the level of the cricoid cartilage (Fig. 13). Preliminary to tracheotomy a bronchoscope was inserted and it was found that there was compression of the trachea almost obliterating its lumen from the level of the suprasternal notch down to the bifurcation. The left bronchus was also compressed. The bronchoscope was allowed to remain in position while the tissues overlying the trachea were separated the tracheal rings were incised the bronchoscope with drawn to the level of the opening in the trachea and a long Jackson cane shaped tracheotomy tube inserted reaching down to the level of the bifurcation. In this way air was carried down to the right lung which was still functioning.

#### BRONCHOSCOPIC AID TO ESOPHAGOSCOPIC FLACUATION OF A RETROPHARYNGOESOPHAGEAL ABSCESS

A boy aged 9 years was admitted to the surgical service of Dr. E. L. Eliason at the University Hospital. One hour before admission he had sustained a stab wound in the front of the neck caused by falling on a sharp portion of a glass bottle. The sharp pointed portion of glass had passed through the trachea and esophagus. His general condition was good but there was present marked subcutaneous emphysema which involved the neck and face up to the level of the zygoma and extended downward over the upper portion of the chest. There was a transverse incision in the front of the neck just below the cricoid level through which air passed on forced breathing. There was no dyspnea and no bleeding. Lateral X ray examination of the neck showed no evidence of glass. Bronchoscopic examination showed a transverse wound in the anterior tracheal wall just below the level of the cricoid and a puncture wound of the party wall into the esophagus at the same level. No foreign body was found. The wound was dressed by packing the skin open so that healing would take place from the trachea outward. The child's condition remained

good until the third day when its temperature rose to 103 degrees F. There developed considerable difficulty in swallowing. The temperature still remained high the difficulty in swallowing increased and there was marked dyspnea. On the fourth day it was thought that the patient was developing a retropharyngeal abscess. On the fifth day following the accident a roentgenogram by Dr. Jancoast showed an enormous retropharyngeal esophageal abscess which was obstructing the larynx from above and compressing the trachea below the level of the cricoid (Fig. 14). On consultation it was decided to evacuate the abscess esophagoscopically. It was deemed advisable to insert a bronchoscope prior to evacuation of the abscess because of the tracheal compression and the danger of aspiration of pus into the lung. On insertion of the bronchoscope pus was found to be coming from the puncture wound on the posterior tracheal wall. The trachea was compressed so that its lumen was slit like down to the level of the suprasternal notch. Dyspnea was entirely relieved by the insertion of the bronchoscope. The abscess was then evacuated through the pharynx by means of the direct laryngoscope used as an esophageal speculum. The posterior pharyngeal wall was incised just above the cricopharyngeal fold and an enormous amount of very foul pus and gas was evacuated the infection being due to some gas producing organism probably colon bacillus. Pus was aspirated from the abscess cavity and the pharynx until the field was clean. The bronchoscope was removed pus being aspirated from the trachea the dyspnea was relieved and the child returned to bed in good condition. The following day there was slight reaccumulation of pus which was aspirated through the incision in the posterior pharyngeal wall the direct laryngoscope being used for exposing the opening in the hypopharynx the patient's head being held low over the edge of the table so as to prevent aspiration of pus into the lung. It was necessary to aspirate the pus in this manner as it reaccumulated on 3 successive days after which time the abscess drained itself without further aspiration and the boy's condition progressed to complete recovery. X ray examination of the neck at the end of one week showed that no evidence of mediastinal infection or retropharyngeal abscess persisted (Fig. 15). Recent bronchoscopic examination showed that only slight stenosis resulted from the tracheal injury. The child's condition was otherwise normal.

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of a trifling trauma. He likewise gives a very good and concise pathological description of his examination.

In our own series it is interesting to note that of the 15 cases in which the pathological or X-ray reports were recorded every one or 100 per cent, showed arteriosclerosis!

#### AGE

Diabetes is a disease of adult life (15) the majority of cases occurring between the third and sixth decades. Of 276 cases (Osler 15) 70 of them 25 per cent, occurred between 50 and 60 years of age. While it is true that diabetes occurs in the very young though rarely with gangrene and at an age too early for arteriosclerosis, the gangrene nevertheless is probably primarily due to a circulatory disturbance in the form of a thrombotic process of thermal or mechanical origin.

Gangrene was found by Morrison (13) to be a contributory cause of death in 23 per cent of 775 fatal cases of diabetes between the years 1895 and 1913. In 84 cases 3 per cent of his series (Table I) Joslin finds a lower relation.

The table below of the ages in which gangrene occurred in 2611 of Joslin's cases is interesting in that he calls attention to the fact that one in every five of his patients who developed diabetes above the age of 70 also developed gangrene whereas the frequency was but half as great in the preceding decade. The average age at which gangrene developed was 61 years.

TABLE I—GANGRENE IN RELATION TO AGE AT ONSET OF DIABETES (JOSLIN)

| Age at onset<br>of diabetes | Total<br>cases | Per cent<br>of cases | Per cent<br>of total |
|-----------------------------|----------------|----------------------|----------------------|
| Under 30 years              | 683            | 4                    | 6                    |
| 30-40 years                 | 5              | 0                    |                      |
| 40-50 years                 | 38             | 1                    | 2.6                  |
| 50-60 years                 | 6              | 1                    | 3.8                  |
| Over 60 years               | 2              | 1                    | 9.5                  |

Joslin looks upon the sixth and seventh decades in life particularly the latter as the dangerous period in diabetes for gangrene and finds the advancing years of duration of diabetes as well as the advancing years of life likewise effective in the production of gangrene.

In our series we find a lower age relation than he does and also a lower age among

females than in males and in diabetics compared with arteriosclerotics. While the average age was 61 years for the development of gangrene in Joslin's series we find the average to be 59.2 years for both sexes, 57.04 years for females and 60.6 years in males or an average of 3.56 years earlier in females than in males. The youngest among our diabetics was a female of 34 and the eldest a male of 79 years of age.

A glance at Table II will show that among our cases 29, 52.7 per cent, occurred in the decade preceding the sixth decade as compared to 16 cases 29 per cent, between the age of 60 and 70 years.

A comparison of the age groups of gangrene in diabetics and in arteriosclerotics reveals the interesting fact that gangrene (in the authors' series) occurs in diabetics a decade before it makes its appearance in sclerotics. This fact leads one to wonder if with its local and general disturbances of metabolism diabetes causes gangrene in the early stage of arteriosclerosis whereas true arteriosclerotic gangrene occurs in the terminal stages of local circulatory impairment. If such is the case then early arteriosclerosis is as serious in diabetics as late sclerosis is in the aged. The average age in which gangrene (arteriosclerotic) occurred in males was 64 years in females 68.66 years in both sexes 64.93 years. And whereas gangrene occurred 3.56 years sooner in diabetic females than in males gangrene in the aged occurred 4.66 years sooner in males than in females.

TABLE II—AGE OCCURRENCE IN ONE HUNDRED CASES OF GANGRENE

| Arterio-<br>sclerosis | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | Ave<br>age | Total |
|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|------------|-------|
| Diabetes              |    |    |    |    |    |    |    |    |    |    |    |    |    | 64.93      | 36    |
| Arterio-<br>sclerosis |    |    |    |    |    |    |    |    |    |    |    |    |    | 68.66      | 31    |
| Total                 |    |    |    |    |    |    |    |    |    |    |    |    |    | 66.80      | 67    |

In the arteriosclerosis group of gangrene the earliest age of incidence was 37 years and the eldest 84 years as compared with 34 years and 79 years in diabetics.

TABLE III—RATIO OF SEX AND DEATH IN GANGRENE

| Form of gangrene | Sex   | Ave age occu | Ave age death | T t l case | P e r c e n t ac | 45 | 5 | 55 | 6 | 65 | 70 | 75 | 80 | T t l d e a t h | M o r t a l i t y | P e r c e n t s e d i |
|------------------|-------|--------------|---------------|------------|------------------|----|---|----|---|----|----|----|----|-----------------|-------------------|-----------------------|
| Arteriosclerosis | M     | 64           | 72            | 36         | 80               | 0  | 0 | 0  | 1 | 1  | 1  | 1  | 3  | 9               | 30                | 35                    |
|                  | F     | 65           | 77            | 9          | 80               | 0  | 0 | 0  | 1 | 1  | 1  | 1  | 3  | 6               | 13                | 66                    |
|                  | Total | 64.93        | 74.76         | 45         | 1                | 0  | 0 | 0  | 2 | 2  | 2  | 2  | 6  | 15              | 43                | 33                    |
| Diabetes         | M     | 60           | 59            | 33         | 60               | 0  | 3 | 3  | 3 | 3  | 3  | 3  | 0  | 3               | 0                 | 33                    |
|                  | F     | 57           | 64            | 22         | 4                | 1  | 4 | 3  | 1 | 1  | 1  | 1  | 0  | 3               | 6                 | 59                    |
|                  | Total | 59.2         | 61.4          | 35         | 1                | 1  | 7 | 6  | 4 | 4  | 4  | 4  | 0  | 6               | 6                 | 43                    |

## SEX

Arteriosclerosis per se is more common among men than women. Diabetes per se remains yet to be determined regarding its sex incidence. Statistics tend to show that diabetes occurs more often in men than in women. As more men than women carry life insurance and urinalyses are performed more often in men and with less hesitancy more cases have been found among males than in females. It is probably true though that in the disease is most common among males.

Oster (15) states that the ratio is as 3 for men to 2 for women. Fitcher (10) in 276 cases found the relation to be 64.85 per cent for males compared with 35.15 per cent for females. Stevas (19) remarks that men are somewhat more frequently affected than women, although apparently more of the latter succumb to the disease. This is in accordance with statistics. In Joslin's series of 355 cases occurring among Jews he noted 171 males and 184 females. It is interesting to note the part the insurance companies are playing in discovering diabetes among otherwise apparently healthy individuals. Joslin states that between 1893 and 1916 6 out of 1,000 of his cases were discovered by insurance companies routine examinations, that it increased to 9 cases during the next four succeeding years and to 13 during the period 1920 to 1923. He further states that sex affects normal metabolism in that females have a lower metabolism than males of the same age height and weight, and in diabetes the same relation holds.

Of 84 cases (Joslin) of gangrene occurring in diabetics more than twice as many males (58 cases) were affected as females (26 cases).

In our own series we find that of 55 cases of gangrene in diabetics the proportion was as

33 males 60 per cent to 22, 40 per cent females. This is surprising in comparison to the relation of sex in our cases of arteriosclerotic gangrene in which the relation in 45 cases was as 36 80 per cent in males to 9 20 per cent in females. The comparison of gangrene in diabetes and in arteriosclerosis in Table III shows that diabetic gangrene occurs earlier than in arteriosclerosis and that the patients die earlier in the disease and at a younger age.

Our statistical analysis shows that the average duration of life in arteriosclerotic gangrene is longer (72.3 years) than in the diabetic form (60.4 years or 72 days) and that the average age of occurrence (64.93 59.2 years) is 5.73 years earlier in the latter form and that they likewise (72.26 59.4 years) die at an earlier age, in fact 12.86 years sooner.

Diabetic gangrene shortens life a full decade more than arteriosclerotic gangrene.

TABLE IV—TRAUMA AS A FACTOR IN GANGRENE

| Dise       | Sex | Trauma | N u m | T t l cases | P e r c e n t |
|------------|-----|--------|-------|-------------|---------------|
| Arterioscl | M   |        | 34    | 36          | 3.55          |
|            | F   |        | 4     | 9           | 55.55         |
| Diabetes   | M   |        | 38    | 45          | 55.55         |
|            | F   |        | 8     | 33          | 45.45         |
| Gangrene   | M   |        | 3     | 55          | 41.85         |
|            | F   |        | 7     | 1           | 3.0           |

For years the profession has been cognizant of the evils that follow trauma in diabetic as well as in the senile cases. Patients have always been cautioned against ill fitting shoes abrasions cuts calluses ingrown toenails and any form of injury that would lead to an open or abraded wound. Poor circulation undoubtedly through poor nourishment favors faulty or non union of such wounds in the aged but while this is true of the patients



of a trifling trauma. He likewise gives a very good and concise pathological description of his examination.

In our own series it is interesting to note that of the 15 cases in which the pathological or x-ray reports were recorded every one or 100 per cent showed arteriosclerosis!

#### AGE

Diabetes is a disease of adult life (15) the majority of cases occurring between the third and sixth decades. Of 276 cases (Osler 15) 70 of them, 25 per cent occurred between 50 and 60 years of age. While it is true that diabetes occurs in the very young though rarely with gangrene and at an age too early for arteriosclerosis the gangrene nevertheless is probably primarily due to a circulatory disturbance in the form of a thrombotic process of thermal or mechanical origin.

Gangrene was found by Morrison (13) to be a contributory cause of death in 23 per cent of 775 fatal cases of diabetes between the years 1895 and 1913. In 84 cases 3 per cent of his series (Table I) Joslin finds a lower relation.

The table below of the ages in which gangrene occurred in 2611 of Joslin's cases is interesting in that he calls attention to the fact that one in every five of his patients who developed diabetes above the age of 70 also developed gangrene whereas the frequency was but half as great in the preceding decade. The average age at which gangrene developed was 61 years.

TABLE I—GANGRENE IN RELATION TO AGE AT ONSET OF DIABETES (JOSLIN)

| Age onset of diabetes | Total cases | With gangrene | Percentage |
|-----------------------|-------------|---------------|------------|
| Under 3 years         | 683         | 4             | 0.6        |
| 3 to 5 years          | 5           | 0             | 0          |
| 5 to 10 years         | 38          | 3             | 8.4        |
| 10 to 20 years        | 6           | 0             | 0          |
| 20 to 30 years        | 2           | 2             | 100        |

Joslin looks upon the sixth and seventh decades in life particularly the latter as the dangerous period in diabetics for gangrene and finds the advancing years of duration of diabetes as well as the advancing years of life, likewise effective in the production of gangrene.

In our series we find a lower age relation than he does and also a lower age among

females than in males and in diabetics compared with arteriosclerotics. While the average age was 61 years for the development of gangrene in Joslin's series we find the average to be 59.2 years for both sexes, 57.04 years for females and 60.6 years in males, or an average of 3.56 years earlier in females than in males. The youngest among our diabetics was a female of 34 and the eldest a male of 79 years of age.

A glance at Table II will show that among our cases 29.527 per cent, occurred in the decade preceding the sixth decade as compared to 16 cases 29 per cent between the age of 60 and 70 years.

A comparison of the age groups of gangrene in diabetics and in arteriosclerotics reveals the interesting fact that gangrene (in the authors series) occurs in diabetics a decade before it makes its appearance in sclerotics. This fact leads one to wonder if with its local and general disturbances of metabolism diabetes causes gangrene in the early stage of arteriosclerosis whereas true arteriosclerotic gangrene occurs in the terminal stages of local or circulatory impairment. If such is the case then early arteriosclerosis is as serious in diabetics as late sclerosis is in the aged. The average age in which gangrene (arteriosclerotic) occurred in males was 64 years in females 68.66 years in both sexes 64.93 years. And whereas gangrene occurred 3.56 years sooner in diabetic females than in males gangrene in the aged occurred 4.66 years sooner in males than in females.

TABLE II—AGE OCCURRENCE IN ONE HUNDRED CASES OF GANGRENE

| Arterio-sclerotic group | 3 | 35 | 40 | 45 | 5  | 55 | 6  | 65 | 7 | 75 | 8    | Average | Total |
|-------------------------|---|----|----|----|----|----|----|----|---|----|------|---------|-------|
| 31 cases<br>2 males     | 0 | 1  | 0  | 0  | 5  | 8  | 7  | 5  | 4 | 5  | 64   | 68.66   | 36    |
| Diabetic<br>31 cases    | 0 | 0  | 0  | 0  | 6  | 7  | 4  | 7  | 4 | 4  | 60.6 | 33      | 33    |
| Total                   | 0 | 1  | 0  | 0  | 11 | 15 | 11 | 11 | 8 | 9  | 62   |         | 69    |

In the arteriosclerosis group of gangrene the earliest age of incidence was 31 years and the eldest 84 years as compared with 34 years and 79 years in diabetics.

TABLE VII—COMPARISON OF HYPERGLAECIA IN RECOVERITS AND FATALITIES

| Sex Outcome         | Males     |       |        | Females   |       |       | Both Sexes |       |       |
|---------------------|-----------|-------|--------|-----------|-------|-------|------------|-------|-------|
|                     | Recovered | Died  | Both   | Recovered | Died  | Both  | Recovered  | Died  | Both  |
| Average age         | 50.3      | 50.38 | 50.35  | 55.77     | 56.44 | 56    | 57.4       | 57.83 | 57.7  |
| Average blood sugar | 299.69    | 318   | 238.79 | 347       | 5     | 278.9 | 53         | 264   | 258.3 |
| Number of cases     | 13        | 6     | 19     | 9         | 9     | 8     |            | 5     | 37    |

Our own experience tends to confirm this and also shows that for a group of people who are relatively younger there is more renal irritation aside from but perhaps due to the glycaemia in diabetes than in arteriosclerosis (Table VI)

Of the 100 cases 56 per cent showed albumin and 30 per cent casts. The diabetics showed a higher percentage (60 per cent) than the seniles (51.5 per cent) of albuminuria and for casts 30.90 per cent as compared with 28.8 per cent. The proportion seemed to coincide.

#### HYPERGLAECIA

Of the 55 cases of gangrene occurring in diabetes 37 occurred after blood chemistry had become well established and the above figures therefore represent 67 per cent of the cases. Among the 37 in which blood sugar estimations were performed 15 died with an average of 268 milligrams of sugar and 22 recovered with an average of 248.59 milligrams. The average for all male cases was 238.79 and for females 277.89. Of the 15 deaths that occurred 6 were in males with an average of 301.83 milligrams and 9 were in females with an average amount of 251 milligrams.

If the above relations hold true for cases other than those of the author's series it would appear that in men the percentage of blood sugar is lower than in women (238.77) but though it is lower the males withstand a higher hyperglycaemia (301.251) than the females before succumbing. Vice versa the women have a higher average of hyperglycaemia (277) and it takes less (251) to prove fatal. Added to this the female dies younger (56.4 years) with less sugar (251) while the male dies at an older age (59.3 years) with more sugar (301).

Compared with the findings in the sex age group it would appear that gangrene in

diabetic females is much more serious than in the opposite sex and that such cases deserve more careful observation with a view to immediate operation (emergency one might say) than the male.

Joslin (Table VIII) believes that the hyperglycaemia difference between decades is slight though in general the younger the patient the lower the sugar.

TABLE VIII—INFLUENCE OF AGE UPON BLOOD SUGAR (JOSLIN)

| Age—Y | Number of cases | Average blood sugar |
|-------|-----------------|---------------------|
| 1     |                 | 9                   |
| 2     | 1               | 9                   |
| 3     | 1               |                     |
| 4     | 1               |                     |
| 5     | 1               |                     |
| 6     | 1               | 0                   |
| 7     | 1               | 0                   |
| 8     | 1               | 0                   |
| 9     | 1               | 0                   |
| 10    | 1               | 0                   |
| 11    | 1               | 0                   |
| 12    | 1               | 0                   |
| 13    | 1               | 0                   |
| 14    | 1               | 0                   |
| 15    | 1               | 0                   |
| 16    | 1               | 0                   |
| 17    | 1               | 0                   |
| 18    | 1               | 0                   |
| 19    | 1               | 0                   |
| 20    | 1               | 0                   |
| 21    | 1               | 0                   |
| 22    | 1               | 0                   |
| 23    | 1               | 0                   |
| 24    | 1               | 0                   |
| 25    | 1               | 0                   |
| 26    | 1               | 0                   |
| 27    | 1               | 0                   |
| 28    | 1               | 0                   |
| 29    | 1               | 0                   |
| 30    | 1               | 0                   |
| 31    | 1               | 0                   |
| 32    | 1               | 0                   |
| 33    | 1               | 0                   |
| 34    | 1               | 0                   |
| 35    | 1               | 0                   |
| 36    | 1               | 0                   |
| 37    | 1               | 0                   |
| 38    | 1               | 0                   |
| 39    | 1               | 0                   |
| 40    | 1               | 0                   |
| 41    | 1               | 0                   |
| 42    | 1               | 0                   |
| 43    | 1               | 0                   |
| 44    | 1               | 0                   |
| 45    | 1               | 0                   |
| 46    | 1               | 0                   |
| 47    | 1               | 0                   |
| 48    | 1               | 0                   |
| 49    | 1               | 0                   |
| 50    | 1               | 0                   |
| 51    | 1               | 0                   |
| 52    | 1               | 0                   |
| 53    | 1               | 0                   |
| 54    | 1               | 0                   |
| 55    | 1               | 0                   |
| 56    | 1               | 0                   |
| 57    | 1               | 0                   |
| 58    | 1               | 0                   |
| 59    | 1               | 0                   |
| 60    | 1               | 0                   |
| 61    | 1               | 0                   |
| 62    | 1               | 0                   |
| 63    | 1               | 0                   |
| 64    | 1               | 0                   |
| 65    | 1               | 0                   |
| 66    | 1               | 0                   |
| 67    | 1               | 0                   |
| 68    | 1               | 0                   |
| 69    | 1               | 0                   |
| 70    | 1               | 0                   |
| 71    | 1               | 0                   |
| 72    | 1               | 0                   |
| 73    | 1               | 0                   |
| 74    | 1               | 0                   |
| 75    | 1               | 0                   |
| 76    | 1               | 0                   |
| 77    | 1               | 0                   |
| 78    | 1               | 0                   |
| 79    | 1               | 0                   |
| 80    | 1               | 0                   |
| 81    | 1               | 0                   |
| 82    | 1               | 0                   |
| 83    | 1               | 0                   |
| 84    | 1               | 0                   |
| 85    | 1               | 0                   |
| 86    | 1               | 0                   |
| 87    | 1               | 0                   |
| 88    | 1               | 0                   |
| 89    | 1               | 0                   |
| 90    | 1               | 0                   |
| 91    | 1               | 0                   |
| 92    | 1               | 0                   |
| 93    | 1               | 0                   |
| 94    | 1               | 0                   |
| 95    | 1               | 0                   |
| 96    | 1               | 0                   |
| 97    | 1               | 0                   |
| 98    | 1               | 0                   |
| 99    | 1               | 0                   |
| 100   | 1               | 0                   |

Regarding the duration of the disease he states that it does not bear a close relation to the percentage of sugar in the blood though in general there is a slight tendency to a slight rise in the blood sugar. It is so moderate however as to afford little support to the theory that diabetes becomes more severe the longer it lasts (Table IX). This is in regard to uncomplicated cases of course for in infections the blood sugar may rise quickly and fluctuate with it.

Coma (10) may or may not increase the percentage of sugar in the blood. If anuria develops the blood sugar will increase. If the urinary volume is well maintained the low diet of coma may lead to a fall in the blood sugar though not to normal. As a rule the lower the carbohydrate tolerance the higher the percentage of blood sugar. The blood sugar percentage at the time of death from various complicating diseases is not distinctive.

#### DIET AND INSULIN

As the diet is distinctly a medical problem the authors refer their readers to standard

in this class it is vastly more important as an etiological factor in those afflicted with faulty metabolism plus faulty circulation as in diabetes. A study of Table IV will show that while trauma occurred more often in women in the senile series and more often among men in the diabetic that the proportion (41.8 to 15.5) was nearly three times as great a factor in diabetes as in arteriosclerosis as the primary cause of gangrene. The percentages of trauma in each sex in the total series of cases are 17 cases of trauma among men 24.6 per cent which is 17 per cent of the total series among the women there were 13 cases of trauma among 31 cases 41.93 per cent in their sex which is 13 per cent of the total.

TABLE V—SCLEROSIS AS A FACTOR IN GANGRENE

| Disease           | Sex    | Present | Absent | Total | Percent |
|-------------------|--------|---------|--------|-------|---------|
| Arteriosclerosis  | Male   | 36      |        | 36    |         |
|                   | Female | 9       |        | 9     | 90      |
| Diabetes mellitus | Male   | 45      |        | 45    | 90.9    |
|                   | Female | 8       | 8      | 16    | 66.6    |
| Total             | Male   | 81      |        | 81    |         |
|                   | Female | 17      | 8      | 25    | 66.5    |

1 diabetic patient in 11 non-diabetic patients dying of gangrene

In supporting the authors' beliefs and those of others that the local circulatory condition is a vital factor in the gangrene that occurs in diabetic patients we would like to call attention to an analysis of the arterial condition of such patients among our series. Of the 55 cases of diabetes the records show that arterial sclerosis was present in 36 cases 66.6 per cent. In the other 19 cases no mention was made of its presence some of them dated back to 1903 and it was therefore impossible to secure accurate data. Inasmuch as gangrene in diabetes (see Table II) occurs about 5 years earlier than in senile arteriosclerosis and 66.6 per cent of the cases in which the condition of the arteries was recorded showed arteriosclerosis and 100 per cent of all pathological and X-ray examinations made showed it to be present it would appear that there can not be any question but that the local arterial condition plays an important part in the causation of gangrene of the extrem-

ities in diabetic patients and is therefore quite analogous in this respect to the senile form of gangrene. Could the other 19 unrecorded cases have been studied as closely as the present ones are it is quite likely that the average of 66.6 per cent would be increased. Coller and Marsh (3) in 20 cases of gangrene of the lower extremities in diabetic patients found no moderate arteriosclerosis but 15 cases 75 per cent of marked sclerosis in uninfected cases at an average age of 64.6 years. In the other five infected cases average age 61 years there was marked arteriosclerosis (100 per cent).

#### RENAL CONDITIONS

Regarding albumin and casts occurring in diabetes Joslin (10) remarks: As a rule when albumin appears the percentage of sugar falls even though the percentage of sugar in the blood remains high. From the time of Kuel the irritation of the kidneys in the first stages of diabetic coma has been observed. Showers of casts may occur at the beginning of diabetic coma. They may appear at times when the albumin amounts to the slightest possible trace. Casts in the urine even in showers do not necessitate the development of fatal coma. Again he remarks: Albumin is frequently observed in the urine of diabetic patients but actual Bright's disease is practically unknown except in cases past 50 years of age. It appears safe to assume that diabetes does not lead to the type of nephritis we include under the term Bright's disease. The association of the two diseases in the latter part of life is not uncommon but the underlying cause of both appears to be the arteriosclerosis of advancing years.

TABLE VI—PERCENTAGE SHOWING ALBUMIN AND CASTS

| Disease          | Sex    | Series | Albumin | Percent | Casts | Percent |
|------------------|--------|--------|---------|---------|-------|---------|
| Arteriosclerosis | Male   | 36     | 5       |         | 9     | 5.0     |
|                  | Female | 9      | 5       | 55.5    |       | 44.4    |
| Diabetes         | Male   | 45     | 3       |         | 3     | 6.6     |
|                  | Female | 16     | 9       | 56.2    | 4     | 25.0    |
| Total            | Male   | 55     | 33      | 60      | 12    | 3.0     |
|                  | Female | 25     | 37      | 53.6    | 4     | 8.0     |
| Total            | Male   | 3      |         |         |       | 3.3     |
|                  | Female | 1      | 50      | 5       | 30    | 3       |

TABLE VII—AREAS MOST FREQUENTLY AFFECTED BY GANGRENE

| Area                  | Arteriosclerosis |      |       |           | Diabetes |      |       |           | Gangrene |      |       |           |
|-----------------------|------------------|------|-------|-----------|----------|------|-------|-----------|----------|------|-------|-----------|
|                       | Recurred         | Died | Total | Mortality | Recurred | Died | Total | Mortality | Recurred | Died | Total | Mortality |
| First toe             | 11               | 3    | 14    | 21.4      | 10       | 0    | 8     | 32        | 3        | 2    | 41    | 28.5      |
| Second toe            | 0                | 1    | 2     | 10.0      | 2        | 1    | 3     | 35        | 4        | 4    | 8     | 5         |
| Third toe             | 0                | 1    | 6     | 16.6      | 0        | 1    | 4     | 75        | 4        | 4    | 8     | 20        |
| Fourth toe            | 5                | 1    | 6     | 16.6      | 0        | 1    | 4     | 1         | 5        | 2    | 7     | 18.5      |
| Fifth toe             | 4                | 3    | 7     | 4.3       | 6        | 4    | 0     | 4         | 7        | 7    | 17    | 41.1      |
| All toes              | 21               | 4    | 25    | 44.4      | 18       | 6    | 24    | 5         | 22       | 13   | 35    | 38.4      |
| First and second toe  | 1                | 1    | 2     | 0         | 0        | 0    | 0     | 0         | 1        | 0    | 1     | 0         |
| Second and third toe  | 2                | 0    | 2     | 0         | 0        | 0    | 0     | 0         | 0        | 0    | 0     | 0         |
| Second and fifth toes | 1                | 0    | 1     | 0         | 0        | 0    | 0     | 0         | 1        | 0    | 1     | 0         |
| Outer foot            | 2                | 0    | 2     | 0         | 0        | 1    | 0     | 0         | 1        | 1    | 2     | 5         |
| Inner foot            | 0                | 0    | 0     | 0         | 0        | 2    | 0     | 5         | 1        | 1    | 2     | 5         |
| Heel                  | 0                | 0    | 0     | 0         | 0        | 0    | 0     | 0         | 1        | 1    | 2     | 5         |
| Sole of foot          | 0                | 0    | 0     | 0         | 0        | 0    | 0     | 0         | 1        | 1    | 2     | 5         |
| Leg ulcers            | 1                | 1    | 2     | 0         | 0        | 0    | 0     | 0         | 0        | 0    | 0     | 0         |
| Total                 | 31               | 14   | 45    | 3         | 3        | 3    | 55    | 4.5       | 63       | 37   | 100   | 37.0      |

It has often been regarded among some men that gangrene occurring in certain toes namely the third fourth and fifth was more dangerous than in others. With a view toward throwing light upon the occurrence of gangrene in a certain toe due to the obliteration of the circulation of that toe and the relative frequency of certain toes being affected more commonly than others we have compiled Table VII.

It will be noted that 75 per cent of the cases occurred in certain toes 17 per cent supposedly in several or more toes and 8 per cent in various portions of the feet. It is to be questioned whether the points of origin so indicated in the group of 17 per cent are accurate and that whether if they could have been studied from their very inception they would not have been found to have originated primarily in one of the five digits and thus have augmented the group of 75 cases which are definite as to their origin. Taking this group as an accurate one it would appear that the most common sites for the origin of gangrene in the lower extremities whether due purely to arteriosclerosis or to diabetes superimposed upon arteriosclerosis are in order the first fifth fourth third and second toes respectively and that most fatalities if any significance can be attached to location occurred in the third second fifth fourth and first respectively.

#### THE USE OF ANÆSTHESIA IN OPERATIONS

Table VIII represents the anæsthetics used in 133 operations in 100 cases of gangrene of

the lower extremities and includes all operative procedures such as incision and drainage femoral sympathectomies amputations reamputations etc.

TABLE VIII—TYPES OF ANÆSTHESIA USED

| Result         | Diabetes |    |    |      | Arteriosclerosis |    |    |      | Diabetes |   |    |      | Both |    |      |     |
|----------------|----------|----|----|------|------------------|----|----|------|----------|---|----|------|------|----|------|-----|
|                | D        | R  | U  | M    | D                | R  | U  | M    | D        | R | U  | M    | D    | R  | U    | M   |
| Spinal or loc. |          |    |    |      |                  |    |    |      |          |   |    |      |      |    |      |     |
| N. 2           |          |    |    |      |                  |    |    |      |          |   |    |      |      |    |      |     |
| N. 2 + 3       | 4        | 0  | 3  | 30.7 | 3                | 1  | 4  | 30.7 | 4        | 3 | 7  | 4.3  | 4    | 3  | 7    | 5.7 |
| Spinal + 1 + 2 |          |    |    |      |                  |    |    |      |          |   |    |      |      |    |      |     |
| Eth.           | 4        | 3  | 9  | 2    | 4                | 4  | 8  | 5    | 8        | 0 | 8  | 0    | 7    | 18 | 38.8 | 0   |
| Chloroform     |          |    |    |      |                  |    |    |      |          |   |    |      |      |    |      |     |
| Hydrocortisone |          |    |    |      |                  |    |    |      |          |   |    |      |      |    |      |     |
| in 100 mg.     | 2        | 3  | 4  | 3    | 0                | 0  | 0  | 0    | 1        | 3 | 4  | 3    | 1    | 3  | 4    | 3   |
| G. 2-eth.      |          |    |    |      |                  |    |    |      |          |   |    |      |      |    |      |     |
| Ethyl-chloride | 0        | 1  | 1  | 1    | 0                | 0  | 0  | 0    | 0        | 0 | 0  | 0    | 0    | 0  | 0    | 0   |
| Total          | 6        | 43 | 50 | 7    | 35               | 38 | 74 | 48.0 | 5        | 8 | 13 | 39.0 |      |    |      |     |

D—Died R—Recurred U—Used M—Mortality

The operations were performed between the years 1903 and 1925. Forty five cases are taken from the records of the Philadelphia General Hospital and 55 from the University Hospital. In all 20 different surgeons are included in the series. The lowest number of operations performed by any one surgeon is 1, 2 and 3 and the highest (in this series only) 14 and 16 respectively. It is interesting to note in going over the individual records that the highest mortality occurred with those surgeons who had only a few cases and vice versa the lowest mortality with those who had the largest number of cases.

Likewise regarding the administration of anæsthetics it should be remembered that the technique of administering local and spinal anæsthetics varied with the different operators.

TABLE IX—RELATION OF BLOOD SUGAR TO PROGRESS (GRAY 10)

| Blood sugar   | No. of cases | Average age of life |
|---------------|--------------|---------------------|
| Less than 190 | 62           | 53.3 years          |
| 190 to 200    | 9            | 57.7 years          |
| 200 to 300    | 45           | 53.3 years          |
| Over 300      | 10           | 66 years            |

works and articles upon the subject, as we believe that this phase of a diabetic's case should be handled entirely by the medical consultant, and that his orders should be adhered to strictly for it is only by the closest and kindest co-operation of the surgeon and the internist that the most can be accomplished. Of the 55 cases, 50 died before and after operation in 5 cases it was impossible to ascertain if they had previously died. These figures were therefore not included.

The administration of insulin too, should be supervised by the internist while the case is in the hands of the surgeon so that the patient may receive a uniform and correct medical care throughout. In this connection we submit the following figures regarding insulinized patients for what they may be worth.

TABLE X—INSULIN IN GANGRENE

| Result      | No. of Cases |      |       | Percent   |      |       |
|-------------|--------------|------|-------|-----------|------|-------|
|             | Recovered    | Died | Total | Recovered | Died | Total |
| Insulin     | 8            | 7    | 15    | 53.3      | 46.6 | 77.7  |
| Non-insulin | 23           | 7    | 30    | 37.5      | 42.5 | 77.7  |

In the limited number of cases (27 per cent) in which it was used 53.3 per cent recovered and 46.6 per cent died, leaving a difference of 6.7 per cent. In the cases in which it was not used (72.7 per cent) more recovered (57.5 per cent) than died (42.5 per cent) the difference being 15 per cent. Of the recoveries 6.7 per cent were given inulin and 12 per cent were not.

Regarding the time at which insulin was resorted to it was noted that in the 15 cases 4 received it only after the operation and 11 were insulinized before and after. Of the former group 6.6 per cent recovered and 20 per cent died. Of the latter group 46.6 per cent recovered and 26.6 per cent died. It

would thus appear that insulin should be given before as well as after operation.

Joslin's advice is to use it to enable you to hasten the removal of the gangrenous area. He also believes that the use of insulin makes it possible to operate early, that the treatment of actual gangrene (10, p. 644) demands the close co-operation between a physician and a real surgeon and that gangrene demands aggressive treatment on the part of the physician and surgeon from start to finish.

Lachy (12) reports 2 cases in middle aged patients with well developed gangrene of the toes in which the use of insulin undoubtedly favored healthy granulations and prevented extensive amputation.

Jones McKatrick and Root (9) write 'We have experimental (11) as well as clinical proof that wounds do not heal well in the presence of a high blood sugar. While it is true that insulin improves the utilization of carbohydrate and for that reason permits wounds to heal that would not have healed formerly, we must not be led into believing that insulin alone will improve the circulation of the extremities with advanced arteriosclerosis.' They (9) give a good outline of pre-operative and postoperative care chiefly for abdominal surgery in diabetes.

#### LOCATION OF GANGRENE

No significance seems to be attached to the location of gangrene regarding right and left. At first it was thought that various anatomical conditions might favor either the right or left side as a place of choice for gangrene particularly the right but an examination of the 100 cases shows that 46 per cent occurred on the right 45 per cent on the left and 9 per cent bilaterally. Bilateral gangrene was twice as common in the seniles (6 cases) as in the diabetics (3 cases).

TABLE XI—LOCATION OF GANGRENE

| Type             | Sex    | Right | Left | Bilateral | Total |
|------------------|--------|-------|------|-----------|-------|
| Arteriosclerotic | Male   | 14    | 7    | 5         | 26    |
|                  | Female | 5     | 3    | 1         | 9     |
| Diabetic         | Male   | 5     | 5    | 1         | 11    |
|                  | Female | 1     | 1    | 1         | 3     |
| Elderly          | Male   | 10    | 3    | 7         | 20    |
|                  | Female | 6     | 3    | 1         | 10    |
| Total            |        | 46    | 45   | 9         | 100   |

amputate. A gangrenous toe in a diabetic on the surface appears to be affected in such a limited small area that physicians frequently are astounded when a surgeon succinctly says

Amputate at the thigh immediately

Superficially, we say that it appears to be a trivial condition but when a careful pathological examination is made of the amputated extremities (witness the attached pathological reports and the findings of Buerger) it is found that the underlying condition of such extremities preclude the fine end results one obtains in amputations performed for traumatism etc. Damaged arteries and veins can not adequately supply tissues which themselves are already undernourished from faulty circulation and metabolism.

The X ray frequently shows arteries in capable of proper function. The value (10) of the roentgen ray in reaching a conclusion as to the desirability of operation is considerable. One obtains in this way both an idea of the condition of the arteries and also of the presence of necrosed or necrosing bone. The damaged hearts, arteries and kidneys among the patients is of equal importance with the diabetes in provoking the serious results.

It will be seen in a comparison of the mortality in amputated (Table XV) and reamputated (Tables XVII and XVIII) cases that it is higher in the latter in the diabetic cases and for diabetes as compared (Table XVI) with arteriosclerosis.

TABLE XVI—COMPARATIVE MORTALITIES OF OPERATION

| Operations                 | Diabetes |      |             | Arteriosclerosis |      |             |
|----------------------------|----------|------|-------------|------------------|------|-------------|
|                            | Cases    | Died | Mortality % | Cases            | Died | Mortality % |
| Amputation & Reamputations | 33       | 5    | 15.2        | 37               | 5    | 13.5        |

\*Two bilateral cases

Since the mortality is 15 per cent higher in reamputated cases of gangrene in diabetes than singly amputated cases and since reamputations are 5 times more dangerous in diabetes than in arteriosclerosis it were far better that a gangrenous diabetic extremity be amputated but once and that at a level that would furnish a sufficient blood supply

a minimum of trauma for artificial extremities (a trauma nearly or equally as dangerous as other forms of trauma in diabetes) and preclude further dangerous and needless operations.

By useless and temporizing operations is meant partial amputations of toes, excision of gangrenous patches, incision and drainage of infected gangrenous areas, long intervals between amputations and femoral sympathectomies. Cases D4, 5, 22, 30 and 34 are examples of conservative operations and waiting too long and represent 50 per cent of the deaths that occurred among the reamputated series or 28.3 per cent of the whole.

The authors are of the opinion that high and immediate amputation should in the majority of cases be performed, because the patients are old and stand bed treatment poorly, becoming incontinent and developing decubitus. Persistent infection prevents proper diabetic improvement. High amputation though giving a higher immediate mortality<sup>1</sup> never necessitates reamputation with its added mortality (30 per cent). Further the high mortality of thigh amputations includes a high percentage of cases that already had been subjected to previous operative results. This mortality is much lower in experienced hands with gas oxygen anaesthesia.

The high amputation (mid thigh) gives the best wound results, immediate and remote because the blood supply is better.

The question of a stump for artificial limbs should never be considered in the aged because in an experience extending over a period of 15 years in handling these cases the senior writer has never been able to induce one of these patients to wear an artificial limb. In fact it is extremely difficult to teach them the use of crutches.

The surgery in these cases should be of the very best and most rapid after medical preparation. With a minimum amount of gas oxygen and without a tourniquet the limb should be removed by the transfixion method with long anteroposterior flaps. Should the tissues not bleed freely the amputation level should be carried higher until free bleeding is encountered. It is well to obtain permission

<sup>1</sup> 5 cases in bed 1 to 14 years.

and their assistants and therefore was not uniform, and that the general anesthetics were administered by various trained anesthetists (physicians and nurses) and a shifting resident staff.

While the analysis does not accurately portray the relative merits of a single anesthesia as administered uniformly with a definite technique by a permanent anesthetist and with the operation performed according to the skill and finished technique of a single operator it does serve as a representative analysis of what the results may be like in a similar number of cases throughout various sections and hospitals with different operators technique etc.

It further goes to show that if the results are less favorable and the mortality higher than in a similar number of cases performed with a definite technique as worked out by a particular and judicious clinic it is high time that steps be taken to adopt a procedure which will work for the welfare of those affected.

In this same light it would be only fair to quote Joslin wherein he remarks "If ether is used it is a good plan to be as rapid and skilled as are the Mayors and to use as little ether as do their anesthetists. Gas and oxygen and spinal anesthesia have been shown to be so superior to ether that in the larger hospitals in Boston it is not the custom to employ it (ether) in operations upon diabetics. chloroform and ether both produce hyperglycemia and are harmful. The administration of ether as given at the Mayo clinic by exceptionally skilled anesthetists where the operation is performed gently rapidly and deftly is quite different from the way it is usually administered. This is typified in Fitz's (4) table in which 36 per cent less ether is given at the Mayo Clinic and in which the period of anesthesia is 53 per cent shorter.

TABLE VII—ETHER IN 100 ABDOMINAL OPERATIONS (FITZ)

| Ave ages per patient             | Mayo Clinic | Co trend Group |
|----------------------------------|-------------|----------------|
| Body weight                      | 64.5 kg     | 63.5 kg        |
| Estimated quantity of anesthesia | 27 c m      | 407 c m        |
| Duration of anesthesia           | 45 min      | 45 min         |

Gas oxygen anesthesia is supposed generally to work well. Joslin finds spinal anesthesia

by far the most satisfactory for amputation of gangrenous legs.

Local anesthesia—novocain nerve block—is probably best used as an adjunct to general anesthesia and shortens the length of employment of the second. One should avoid trauma in its use and remember that it is an extra burden, locally for already weakened tissue to carry.

In our own series (see Table VIII) of diabetic cases the relative mortality of the various anesthetics were as follows: Gas and ether, none; nitrous oxide 42.5 per cent; ether 50 per cent; spinal novocain 50 per cent, and spinal cocaine 100 per cent. As there were no deaths from anesthesia the above mortalities are naturally indirect. Likewise due to the multiplicity of operators it does not give a fair comparison of anesthesia values as would be the case in a single clinic controlled by the best and most rigid technique requirements.

Coller (3) believes chloroform ether and local anesthesia should not be used and prefers spinal anesthesia or ethylene with oxygen.

#### LEVELS OF OPERATION

The two questions which concern the average surgeon most when he is called to see a case of diabetes mellitus suffering with early gangrene of an extremity is when to operate and at what level amputation had best be performed. With the dry type of gangrene operation may more safely be deferred than in the moist type. The moist type is more apt to be infectious. Infection spells danger.

TABLE XI—LEVELS OF AMPUTATION

| Is it amputated      | Sclerotic |        |                   | Diabetes |        |                   |
|----------------------|-----------|--------|-------------------|----------|--------|-------------------|
|                      | Case      | Deaths | Mortality Percent | Case     | Deaths | Mortality Percent |
| Too weak to amputate | 6         |        | 33.3              | 21       |        | 15.2              |
| A little bit of it   | 9         | 0      | 0                 | 7        | 4      | 57.1              |
| Amputated            | 0         | 0      | 0                 | 2        |        | 0                 |

Seven deaths occurred within week after being from the hospital. Fifteen deaths occurred within 46 days after being from the hospital. Sixteen cases (both were cured) in which 37 treatments effected in 35 cases.

There is too often the double and dangerous tendency of procrastination as to when to operate and temporizing as to how high to





to do this in those patients who demand a low amputation. The transfixion method is the most rapid and at the same time results in less injury to small vessels than does the dissection necessary in the shaped flap methods. The flaps should be dropped together over a dry field and loose interrupted sutures of catgut applied, encompassing the skin subcutaneous tissue and superficial muscle sheath. Catgut is used because it is elastic and will give when the tissues swell under a light suture. A rubber wick down to the oozing bone which is kept in place for 24 hours gives best results. The stump is bound loosely and kept warm.

Contrary to some views are Joslin's statements as follows: 'In Boston increasingly often amputation is done below rather than above the knee and in many of the recent cases so sure are these operators of their technique that the wounds are closed without drainage. It is two years since any anaesthetics save spinal anaesthesia or gas and oxygen have been employed. During the operation the use of a tourniquet is avoided. The choice of the site of amputation is increasingly in favor of the leg over the thigh. With removal of the leg there is less shock and the opportunity for adjustment of an artificial leg is far better. Of 32 cases operated upon between the years 1916 and 1922 at the Boston City Hospital the percentage of recovery was 100 per cent for leg amputations (5 cases), 83 per cent for thigh amputations (18 cases) and 27 per cent for foot amputations (7 cases).

Stetten and Burnheim (19) are to be commended in their energetic treatment of the cases in which they were able to avoid operation. Others less energetic will be less successful. So long as the consulting surgeon agrees that satisfactory progress is taking place well and good but, if he is in doubt operate immediately.

Phillips and Tunnock (16) have had very good immediate results in roentgen ray therapy of thrombo-angitis obliterans. Others have attempted femoral sympathectomies and still others have in mild cases (under diet and insulin for some time previous) claimed good immediate results in amputation of the toes in the dry form of gangrene.

TABLE VIII.—AMPUTATIONS IN ARTERIO-SCLEROSIS

| No. | Case | Origin of disease | Date of operation | Result           | Site of operation   | Time in theatre | Remarks             | 3rd operation    | Result      | Remarks           |
|-----|------|-------------------|-------------------|------------------|---------------------|-----------------|---------------------|------------------|-------------|-------------------|
| 1   | A-7  | 4th d. 4th d.     | 4th toe amputated | C. 4th d. 4th d. | 11 1/2 h. 11 1/2 h. | 6 h. 30 m.      | 5 days. 11 d. 11 d. | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 2   | A-9  | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 3   | A-10 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 4   | A-11 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 5   | A-12 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 6   | A-13 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 7   | A-14 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 8   | A-15 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 9   | A-16 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |
| 10  | A-17 | 4th d.            | Amputated         | 4th d.           | 11 1/2 h.           | 5 h.            | 11 d.               | 3 ch. 100 w. 100 | Healed 4 w. | 11 m. 11 m. 11 m. |

TABLE XVIII--REAMPUTATIONS IN DIABETIS

[illegible]

to do this in those patients who demand a low amputation. The transfexion method is the most rapid and at the same time results in less injury to small vessels than does the dissection necessary in the shaped flap methods. The flaps should be dropped to gether over a dry field and loose interrupted sutures of catgut applied encompassing the skin subcutaneous tissue and superficial muscle sheath. Catgut is used because it is elastic and will give when the tissues swell under a light suture. A rubber wick down to the oozing bone which is kept in place for 24 hours gives best results. The stump is bound loosely and kept warm.

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TABLE \VII --REAMPUTATIONS IN ARTERIOSCLEROSIS

[illegible]

TABLE XV—REAMPUTATIONS IN DIABETIS

| N | C <sup>no</sup><br>No. | O <sup>let</sup><br>No. | t <sup>Op</sup><br>Op | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d <sup>Op</sup><br>Op | Time | R alt | d 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o nse i of 36 qur d mp sat 3600 per cent (int d r f l t g f b l a s ) w e a f i g 6 o p e r a t i o n s = 1 0 p e r c e n t o p e a l i v e

The authors, however are of the opinion that though good immediate results are frequently and apparently obtainable from low level amputations the best end results will be obtained in those cases that are immediately given higher amputations thus avoiding an ultimate recurrence of gangrene at a higher level due to arteries and tissues which are incapable of regeneration or maintaining it.

Coller and Marsh (3) noted a lower mortality and better results in their non infected cases and concur in the general opinion that it is safer to wait longer in the dry than in the moist infectious type. To quote "In our experience there are two sites at which amputation may be successful. In those cases in which there is gangrene of a toe with a sharp line of demarcation distal to the plantar arch amputation of a toe usually is successful. The amputation must be done without trauma no closure attempted and the wound allowed to heal by granulation. Of course gangrene of the other toes may occur at a later date. If the gangrene extends into the foot either primarily or following a toe amputation a thigh amputation should be performed. It should be emphasized that the sclerous involves the entire arterial tree and dissections of amputated legs have shown that the narrowest part of the vessel is often in the first part of the popliteal arteries. Amputations through the leg usually fail to heal because of sloughing of the flaps and are not worth trying. The thigh is selected as the site for amputation because it is the lowest point at which healing is likely to occur and because the patient is not in a condition to stand a series of anæsthesias and operations."

#### RELATION OF PRE-OPERATIVE TO POST-OPERATIVE DAYS AND END RESULTS

A very careful analysis was attempted of all the cases in the series to determine the relation of how long it is safe to wait before amputating gangrenous extremities. It was soon found that this could not be done with sufficient accuracy to warrant its presentation to the profession so that proper inferences could be drawn. The reason for this being that the type of patient and the judgment of the private physician who referred the case

for hospital care varied so widely. Some patients for example refused to go to a hospital for care until the gangrene had well advanced to the malleoli and with its consequent infection, even immediate operation was of no avail to save a patient that was already in the late stage of acidosis. Then again in most cases the exact onset of premonitory symptoms and the actual gangrene could not be accurately ascertained.

It may be interesting and illuminating to note that the patients that fare the best and in whom the end results are superior to those found in all others are those who have been sent to the hospital by their private physicians as soon as the first sign of infection about a toe nail, callus or blister appeared and in those cases which while being treated in the medical wards for diabetes developed gangrene of a toe and were immediately seen and there after closely observed by a surgical consultant.

The cases of so-called diabetic gangrene treated of late years have been admitted at a much earlier stage with the result that a much more favorable outcome has resulted. So we are led to hope that even this may be improved upon so that the patients may eventually be admitted at the very inception of their condition.

#### WOUND RESULTS

The immediate and end results differ in both the purely arteriosclerotic gangrene cases and those of arteriosclerosis with diabetes mellitus. In the former there is less infection of wounds, less necrosis of tissue, less recurrence of gangrene and more cases of primary union.

TABLE XIX - WOUND RESULT IN GANGRENE

| Wound Result       | Healed |          | Died  |          | Both  |          |
|--------------------|--------|----------|-------|----------|-------|----------|
|                    | Cases  | Per cent | Cases | Per cent | Cases | Per cent |
| End of day         | 3      | 0.0      | 7     | 7        |       |          |
| Non-treated        | 5      | 55.5     | 3     | 4        | 48    | 52.8     |
| Infect. & supp.    |        | 0.6      | 5     | 3.8      | 1     | 3        |
| Ca. & nec. & supp. | 5      |          |       | 1        |       |          |
| Total              | 43     | 99.8     | 33    | 99.8     | 49    | 100      |

Table XIX shows the relations of the above factors except primary union regarding

which it was found that the percentage in the first type of gangrene was 17.7 per cent and 55 per cent for the second.

Obviously local factors (circulation, local tissue metabolism and general body metabolism or blood chemical conditions) are less in favor for wound results in amputation among those who have diabetes mellitus.

Our experience regarding closure and drainage of amputation wounds in diabetes tends to confirm the experience of the Boston City Hospital operators in that more wounds (40 per cent) healed when closed without drainage than with any other form of technique used. The relative results of the various methods are shown in Table XX.

TABLE XX—RELATION OF CLOSURE AND DRAINAGE TO HEALING

| Technique used          | Wound     | Arterio-venous |          | Diabetic |          |
|-------------------------|-----------|----------------|----------|----------|----------|
|                         |           | Case           | Per cent | Case     | Per cent |
| Closed and drained      | Healed 10 | 9              | 90       | 7        | 70       |
| Closed and not drained  | Healed 10 | 3              | 30       | 4        | 40       |
| Not closed, but drained | Healed 10 | 9              | 90       | 6        | 60       |
| Not closed, not drained | Healed 10 | 1              | 10       | 4        | 40       |
|                         | Healed 10 | 1              | 10       | 1        | 10       |

It will likewise be noticed (Table XXI) that wounds heal more quickly in the non-diabetic than in the diabetic. This may be observed in other surgical conditions in diabetes: carbuncles, fistula, incisions, etc.

TABLE XXI—AVERAGE DAYS FOR STUMP TO HEAL IN GANGRENE

| Wound results       | Non-diabetic |      | Diabetic |      | Both  |      |
|---------------------|--------------|------|----------|------|-------|------|
|                     | Cases        | Days | Cases    | Days | Cases | Days |
| Healed in hospital  | 4            | 44.6 | 4        | 46.8 | 34    | 45.5 |
| Healed on discharge | 4            | 44.5 | 7        | 43.7 | 8     | 44.9 |
| Healed in hospital  | 45           | 38   | 55       | 35.3 |       | 36.6 |

#### ACIDOSIS AND COMA

Twenty-two cases out of the 55 diabetics developed acidosis, representing 40 per cent of the series. Of this number 13, 59 per cent recovered and nine cases, 41 per cent died.

Of the 55 cases of diabetes, 9 cases, 16 per cent succumbed to acidosis. The deaths from all causes amounted to 24, 43.6 per cent, and as 9 of the 24 deaths were due to acidosis, the diabetic mortality due to acidosis was 37.5 per cent.

Since 37.5 per cent of the deaths were due to acidosis, it behooves us to prevent acidosis from occurring by using proper technique: anesthesia, diet and insulin, by avoiding temporary operations and the loss of valuable time before operating by employing the least number of operations in each case by amputating at a level at which the circulation will be highly sufficient to supply the part adequately and to assure healing lastly, but not least, by the use of exercises to help the body burn its excess sugar by employing rigid hygiene and asepsis to prevent infection of the operative wound, and by co-operating closely with the internist from the time the patient first presents himself. Could acidosis have been prevented among the 9 cases of this series, the mortality would have been 27 per cent instead of 43.6 per cent. This should awaken us to the significance of acidosis and cause us to use every effort to prevent its occurrence.

Acidosis is increased by infections. Acidosis when severe frequently terminates in coma and death. It is therefore of primary importance to combat all infections early. Joslin has shown in the figures below the percentage of deaths due to coma at different age periods.

| Age period | Total deaths | Coma | Per cent |
|------------|--------------|------|----------|
| 10-30      | 19           | 9    | 86       |
| 31-40      | 19           | 4    | 7        |
| 41-50      | 17           | 14   | 82       |
| 51-60      | 3            | 3    | 100      |

Graham (7) reports 7 cases of coma in diabetic cases in which infection was present and was probably responsible for sending the patients into coma. Most of them had had diabetes for some years and their condition was never serious until the advent of the infection. He concludes that in cases of local and general bacterial infection, insulin is much less effective in lowering the blood sugar.

Evidence is presented by Richardson and Leonie (17) that the ill effects of infection in

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TABLE XIX.—WOUND RESULT IN GANGRENE

| Wound site                     | Arterio |          | Diabetic |          | Both |          |
|--------------------------------|---------|----------|----------|----------|------|----------|
|                                | Case    | Per cent | Case     | Per cent | Case | Per cent |
| Lost to medical—died in 3rd yr | 3       | 6.6      | 7        | 7        | 48   | 3        |
| Non infected                   | 5       | 55.5     | 3        | 3        |      |          |
| Infected & healed              | 1       | 6.6      | 5        | 5        | 5    | 3        |
| Gangrene & infected            | 5       | 1        | 7        | 7        |      |          |
| Total                          | 41      | 99.2     | 12       | 99.8     | 100  | 99       |

Table XIX shows the relations of the above factors except primary union regarding

prove fatal. These conditions develop at a time in life when diabetes is mild and why should they so frequently be fatal? Consider with what these mild cases of diabetes have to contend. Handicapped by a lingering infection which only too often is allowed to continue for months with kidney's less efficient for throwing off the attack of acidosis, deprived of exercise—that proved stimulus to sugar consumption—for whoever heard of a poor old gangrenous diabetic taking exercise these patients frequently meet a fourth enemy in the anaesthesia. Is it any wonder that a formerly innocent disease becomes more virulent and the victim dies of coma? There is no doubt in my mind but that if such cases had been treated vigorously even with the diabetic methods of a few years ago a large percentage of the legs amputated might have been saved.

'All are well aware that if a diabetic patient has gall stones to be removed he instantly commands the services of the leading surgeon on the senior staff but if a diabetic patient has a sore toe there is no house officer too young to dress it until a few weeks later if the patient survives that long the surgeon in the amphitheatre amputates the thigh. No matter how trivial the ailment secure the very best surgical skill for a surgical diabetic.

#### EXERCISE IN DIABETES

It has been proved that physical activity decreases the blood sugar content. Gordon and others (6) were able to obtain very good data concerning this factor from the examination of marathon runners. Hodgson (8) advises that diabetic patients be kept mentally indolent and physically active. This is well illustrated in cases 1889 and 22 of Joslin's series in which the first while taking insulin walked 10 miles a day and occasionally there by accelerated an hypoglycaemia reaction. The second case (a Harvard professor) was conscious of this fact regarding his periods of well being and himself remarked mental work makes sugar manual work burns it up.

Salaguchi (18) found the blood sugar lowered by exercise. Nehring and Schmoll concluded that unusual activity in diabetics was also at the expense of glycogen (Van Noor

den 22, cites differences) from the fact that it is possible in many instances to reduce the sugar excretion by controlling the muscular activity.

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All are well aware that if a diabetic patient has gall stones to be removed he instantly commands the services of the leading surgeon on the senior staff but if a diabetic patient has a sore toe there is no house officer too young to dress it until a few weeks later if the patient survives that long the surgeon in the amphitheatre amputates the thigh. No matter how trivial the ailment secure the very best surgical skill for a surgical diabetic.

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It has been proved that physical activity decreases the blood sugar content. Gordon and others (6) were able to obtain very good data concerning this factor from the examination of marathon runners. Hodgson (8) advises that diabetic patients be kept mentally indolent and physically active. This is well illustrated in cases r88g and - of Joslin's series in which the first while taking insulin walked 20 miles a day and occasionally there by accelerated an hypoglycemia reaction. The second case (a Harvard professor) was conscious of this fact regarding his periods of well being and himself remarked mental work makes sugar manual work burns it up. Sakaguchi (r8) found the blood sugar lowered by exercise. Nehring and Schmoll concluded that unusual activity in diabetes was also at the expense of glycogen (Van Noor

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## SUBACUTE ILEOCOLIC INTUSSUSCEPTION SECONDARY TO CARCINOMA OF THE ILEUM

By J G PROBSTEIN M D AND M G SEELIG M D F A C S St LOUIS  
 From the Surgical Service of the Jewish Hospital

CARCINOMA of the small intestine is rather infrequent. It occurs in about 3 per cent of all carcinomatous conditions of the entire intestinal tract (3). There are three common sites for carcinoma of the small intestine: the duodenum, jejunum and ileum, the duodenum being the most frequent site of election, while the ileum appears to be the site least frequently attacked. The reverse is true of sarcoma when it occurs in the intestinal tract (1). When duodenal carcinoma does occur it is usually found at or in the vicinity of the ampulla of Vater in 70 per cent of cases.

In 4188 necropsies performed at the Vienna General Hospital 3585 were cases of carcinoma of these 343 cases were in the intestinal tract and only 11 in the small bowel (6). Judd states that carcinoma of the intestine has occurred 24 times in the small intestine as compared with 1822 times in the large bowel and rectum and 1689 times in the stomach (5).

Intussusception is the cause of intestinal obstruction in one third of all cases (8). Acute intussusception occurs most frequently in infants and young adults being the most common cause of obstruction during this age. There are four chief varieties of intussusception: ileocaecal in which the ileum and ileocaecal valve pass into the caecum; colic in which the large intestine is prolapsed into itself; ileal in which the small intestine is prolapsed into itself; and ileocolic in which the ileum passes through the ileocaecal valve into the caecum. The ileocaecal type is the most frequent while the ileocolic is least frequent. Rushmore states that in 237 cases of intussusception 140 were of the ileocaecal variety and only 31 of the ileocolic type (8).

Rose and Carless state that the ileocaecal variety of intussusception occurs in about 44 per cent while the ileocolic variety is found in about 8 per cent of cases (7).

Chronic intussusception occurs more frequently in adults and the aged, the onset being gradual and the course varying widely in its symptoms. The etiological factor in chronic intussusception is usually neoplasm, foreign bodies, cicatricial contractions or bands and faecal impactions. Of these neoplasms and faecal impactions are the most frequent causes found.

The symptoms of acute intussusception are well known and are very different from those due to chronic intussusception. The patient becomes suddenly ill, is seized with severe abdominal pain and almost thrown into a state of shock. The pain is usually diffuse throughout the abdomen and followed by vomiting. Absolute constipation is not the usual rule, diarrhoea and blood stained feces associated with tenesmus are very common. These symptoms lead to collapse and death of the patient if interference and relief is not afforded promptly.

The symptoms of chronic intussusception are usually very gradual in onset and not so stormy. The patient complains of intermittent attacks of colic like pain which usually becomes more severe and intense as the course of the disease progresses. Vomiting may or may not be present, the bowels may have no abnormal action or may at times develop tenesmus. The condition continues for weeks unrecognized until either discovered accidentally at operation or in the minority of cases diagnosed before operation. Gruner and Fraser have reported two cases of symptomless tumors occurring in the ileum (4).

## REPORT OF CASE

Subacute ileocolic intussusception secondary to carcinoma of ileum. H G, male aged 35 years, white.

**Chief complaint.** Patient complained of cramps which were generalized throughout the abdomen and had been present for 2 weeks. The cramps occurred daily at 11:30 a.m. and ceased between 5:00 and 6:00 p.m. The pain usually made its

11 Females appear to die younger with a lower hyperglycemia than males who live longer with a higher blood sugar content

12 Insulin and diet should be used before and after operation when possible but operation should first be performed in the majority of cases

13 No importance is attached by the authors to the location of the origin of gangrene (i.e., right or left, first or second toes etc.) as it is a question of arteriosclerosis higher up

14 The choice of anesthetics appears to be gas-oxygen, short ether and spinal

15 Operate early and high with less thought of the stump and artificial limb than of reamputation and its high mortality

16 Wounds should be closed with loosely interrupted catgut suture and a rubber wick for 24 hours

17 Patients should be sent to the hospital when the first sign of infection develops about a toe nail blister abrasion etc rather than after gangrene has made its appearance

18 The closest co-operation between internist and surgeon should govern the treatment of the case

19 Early and non temporizing operations should be the rule and not the exception

20 Severe infection spells acidosis Severe acidosis spells death

21 The operative mortality in senile cases was nil in diabetic, 3.6 per cent

22 Mental work produces sugar physical

work burns it Exercise even in bedridden patients must be insisted upon

23 Diabetics are to be continually advised and warned regarding hygiene and care of the extremities

This series leads us to advise proper medical preparation early high amputation done with speed and care under careful gas oxygen or short ether anaesthesia closing the wounds with loosely applied elastic sutures

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at first to be a retroperitoneal lipoma because of consistency it was soft and in outline lobulated. Further investigation disclosed that the mass was within the lumen of the ascending colon and consisted of ileum which had entered the intussusception through the ileocaecal opening. Reduction was accomplished with some difficulty on account of the edematous bulk of intussuscepted small intestine. About 12 inches of this intussuscepted bowel was released. There was a hard flat tumor about 1.5 inches in diameter occupying the surface of the intussuscepted bowel opposite the mesentery. The center of the tumor was umbilicated (Fig. 1). This tumor was situated near the cecal end of the intussuscepted bowel. There were no visible or palpable lymph glands. A diagnosis of malignant tumor probably carcinoma was made and intestinal resection was decided upon. About 12 inches of ileum were resected and an end-to-end anastomosis was made.

Convalescence was uneventful the patient leaving the hospital on the eighteenth day.

**Microscopical examination.** The pathologist Dr. Lyles reported the following: Specimen revealed a portion of bowel 10 inches in length. There is a tumor in the wall which apparently involves its entire thickness (Fig. 2). It is button shaped 25 millimeters in diameter and its average thickness is about 9 millimeters. Section of the mass shows a cellular tumor with little stroma. The cells are large and epithelial like with numerous mitotic figures (Fig. 3). Diagnosis: undifferentiated carcinoma of solid type.

**Subsequent course.** Patient was given deep X-ray treatment by Dr. Schnobelen. When seen on April 1, 1926 twelve months after operation patient stated that he felt well except for a backache (diagnosed as a spondylitis by Dr. P. Hoffman). He weighs 170 pounds, his appetite is good and his bowels move every day.

On fluoroscopic examination the roentgenologist Dr. Schnobelen reported the following: Radioscopic examination of the colon shows twelve hours after barium meal a small amount of barium

is found in the terminal ileum the caecum is partially filled and a small amount is present in the ascending colon. Barium enters the rectal pouch in the usual position. The sigmoid raises up well out of the pelvis and is not redundant. The entire descending colon is well filled about 2.5 centimeters in width. The splenic flexure is in the usual position. The transverse colon is well filled slightly redundant and crosses the abdomen below the umbilicus 3 centimeters in width. The hepatic flexure is in the usual position. The ascending colon is well filled 3 to 4 centimeters in width. The caecum is well filled with barium and is smooth. Barium is noted passing through the ileocaecal valve there is no evidence of defects or diverticula no spasticity or unusual redundancy. Conclusion: X-ray negative.

**Epicritical remarks.** This case is unusual and interesting because it deals with carcinoma of the small bowel in a young individual and because the intussusception that resulted ran a course strikingly like acute appendicitis without any clinical signs of intestinal obstruction despite the fact that at operation it was clearly demonstrated that the ascending colon was completely blocked.

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Fig 1 Showing the umbilicated tumor arising in mucous membrane of the ileum



Fig 2 Microphotograph (low power) of tumor infiltrating entire thickness of intestinal wall

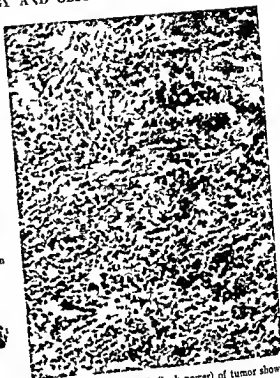


Fig 3 Microphotograph (high power) of tumor showing numerous mitotic figures

appearance about 4 hours after the morning meal. Because of the onset of the pain this was the only meal he would eat each day. His bowels moved every day he was not nauseated and did not vomit. He had no urinary symptoms and had noticed no loss of weight.

**Physical examination.** Temperature was 99.4, pulse 80. The examination of head, neck and chest was negative. The abdomen showed no visible peristalsis, no definite point of tenderness, no masses, no rigidity of abdominal muscle. Rectal examinations were negative.

**Diagnosis.** Undetermined. Patient is to be observed and to be seen the next day. Forty-eight hours later the patient was seized with a very severe attack of pain. A colleague called in the emergency made a diagnosis of appendicitis and advised immediate operation. The patient desiring further consultation came to my office. He stated that he had been free from cramps during the previous day but that today he commenced having the usual pain following his breakfast. The pain was colic like and came in the afternoon. The pain was colic like and came

to center chiefly in the right side. There was no nausea or vomiting, the bowels moved very well that day.

**Physical examination.** Temperature was 99.4, pulse 90, head and chest negative. On inspection of the abdomen we found a definite tenderness over McBurney's point and rigidity of the right rectus muscle. No visible peristalsis. On deep palpation a mass the size of a small fist could be felt in the right lower quadrant. This mass was tender and slightly movable. Rectal examination was negative. Urine examination negative. White blood cells 9000.

**Diagnosis.** appendicular abscess. Diagnosis confirmed by Dr. Lister Fuhlske. No pituitary adenoma but refused.

Five hours later the pain had become so intense that the patient had to be transported to the hospital. On admission the physical findings were the same as above. Laboratory report showed urine negative, white blood cells 12,500. Diagnosis of appendicular abscess was confirmed by Dr. M. G. S. who advised immediate operation.

**Operation.** Through a right rectus incision the peritoneum was opened. No free fluid was found. A normal appendix was delivered into the wound. The appendix was removed and the abdomen explored. A mass the size of an adult fist was felt in the region of the ascending colon. It seemed



FIG. 1 R. M. A low power microphotograph showing in the center the fistulous tract lined partly with squamous epithelium and partly with infected granulation tissue. In the surrounding striated muscle can be seen four small bundles of nerves (1) accompanying vessels. No other nerves were found.

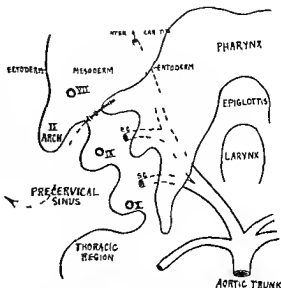


Fig. 2 Embryo of mole showing relation of nerves and arches, the site of the precervical sinus, and the path of a complete branchial fistula (—) with the break through the mesoderm into the pharynx (---) (Schematic cross section after Rabi, drawn by Dr. J. Alonzo).

small vessels and accompanying these in each case a very small bundle of nerve fibrils. On account of the type of fixation and embedding it was not possible to demonstrate whether these were myelinated or not, but the assumption seems reasonable that they are simply nerve twigs supplying the striated muscle. No nerve bundles could be found in the connective tissue immediately about the fistulous tract (Fig. 1).

**Progress notes.** The cough stopped on the day of operation and the wound healed by primary union.

**Follow up notes.** December 3, 1923. The wound is baritone in character. There has been no recurrence of swelling, discharge, or cough.

May 10, 1925. End result excellent. No cough.

November 10, 1925. No recurrence. No cough.

operation failed to disclose such an opening. There was a lack of recurrence. These facts would seem to eliminate the possibility of a cough produced by intermittent discharge into the pharynx.

The clinical symptoms, the findings at operation, and the end result in this case emphasize the importance of a correct understanding of the relation of branchial fistula to irritation of the vagus. Such an understanding necessitates a knowledge of the embryology of the branchial arches and their nerves. The conclusions of Sutton and also of Cusset who have investigated this subject is that there are in the embryo of the lower animals five branchial arches separated by five clefts and that if any of the lower clefts is not obliterated by the growth of the corresponding arch, an abnormality such as a branchial fistula will result. These observers have assumed that the situation in the human embryo is analogous. Whether or not this assumption is correct, two conditions in the anatomy of branchial fistula cannot be explained under this theory. Clinical observations have shown first that the external opening of the fistula occurs in several different

The history of branchial fistula in this case is definite with a hacking unproductive cough which persisted for 2 years during which time discharge from and inflammatory reaction in the branchial fistula took place. The cough was not relieved by a tonsillectomy or by medical measures. At operation the wall of the tract was found in contact with the vagus and slightly adherent to it at a point where the sensory fibers to the larynx are. A chronic irritation of this section of the nerve by the inflammatory sinus tract produced a cough which was stopped after operation. The tract was not injected prior to operation to demonstrate the possibility of a pharyngeal opening and investigation at

BRANCHIAL FISTULA—ITS CLINICAL RELATION TO IRRITATION OF THE VAGUS<sup>1</sup>

By LOUIS CARP, M.D., F.A.C.S., New York  
 Lecturer in Surgery of the College of Physicians and Surgeons, Columbia University

THE uncertainty surrounding the origin of branchial fistula has given rise to a great deal of discussion. This has been of a theoretical character for no acceptable proof has been offered that the branchial arches in the human behave in the same manner as do those in lower animals. Monographs in French, German and Latin are quite numerous including those by Hunzowski, Dzondi, Asherson, Heusinger, Cusset, Quenu, and Wenglowski. In this country, Whitacre has produced an excellent practical consideration of the subject and Coplin a beautiful description of the microscopic pathology, Coplin laying especial emphasis on the lymphoid elements in the wall of the tract which had previously been observed by Sulzka and later by Broca, Salin and Mohod. Considering the vast amount that has been written there have been very few references to symptoms of nervous origin in connection with branchial fistula.

The following case of branchial fistula with clinical symptoms of vagus nerve irritation which were relieved promptly by excision of the tract stimulated me to consider the subject at some length.

R. S. schoolboy, American, referred by Dr. Mahan, aged 5, gave as a chief complaint a discharging sinus in the right side of the neck.

When the child was born the mother noticed in the front part of the right side of the neck a small reddish raw area about the size of the head of a pin. She paid no attention to it until 2 years ago when the swelling opened and discharged a small amount of mucoid material. After that time the opening in the neck closed and opened intermittently the discharge being more profuse when the child had a cold. Occasionally a small swelling formed about the opening. For 2 years the boy had a dry hacking cough which was more pronounced at night and when the sinus was not discharging.

The child was of breech birth and was breast fed. He had bilateral otitis media in infancy. Tonsils and adenoids were removed 1 year ago to cure his cough but without any remedial effect. He had chicken pox 2 years ago. The family history is negative.

Physical examination showed the patient active and not acutely ill. He wore glasses for slight strabismus. Ears, nose, throat, larynx, heart, lungs and extremities were negative.

**Surgical condition.** In the right cervical region at the anterior border of the sternomastoid about 3 centimeters above the sternoclavicular junction was a soft non-tender fluctuating reddish cystic mass 3 millimeters in diameter with a red dot in the center which was closed. The cystic mass became a little larger on coughing. No attempt was made to probe or to inject any fluid into it to determine its course or patency. A diagnosis of branchial fistula was made and operation advised.

**Operation.** May 7, 1913. Ether anesthesia. An incision 3 centimeters long was made over the anterior border of the sternomastoid and the cystic mass excised. There was a distinct tract which went through the platysma, the sheath of the sternomastoid and the carotid sheath between the carotid artery, internal jugular vein and vagus nerve. It was in intimate contact with the vagus for a short distance and slightly adherent to it at one point. It then coursed obliquely upward and backward toward the pharynx but a probe in the tract could not demonstrate an opening into the pharynx. The pharyngeal end was very thin and fragile.

The sinus tract was carefully dissected out by blunt and sharp dissection after the sternomastoid, carotid artery and internal jugular vein had been retracted. At the pharyngeal end the tube tore off. The remaining tissue was carbonized. Plain catgut was used to close the platysma and fascia subcuticular plain catgut for skin.

The specimen is 3 centimeters in length and 1/4 centimeter in diameter. The outer surface is uneven and the cut surface shows a lumen containing mucoid material surrounded by an elastic wall. The microscopic examination shows a tubular structure lined by stratified flat epithelium. There is a marked subepithelial inflammatory cell infiltration. The surrounding muscle tissue is markedly edematous.

Subsequently, Dr. A. Purdy Stout was requested to see the slide and to make a report with special reference to the presence of nerves in the wall of the tract. The following is his report:

A number of slides were prepared from the paraffin block submitted. They all show essentially the same picture. There is a very small fistulous tract lined with stratified squamous epithelium with a great deal of lymphoid tissue immediately surrounding it. The tract passes through a mass of striated muscle. This is supplied by at least three groups of

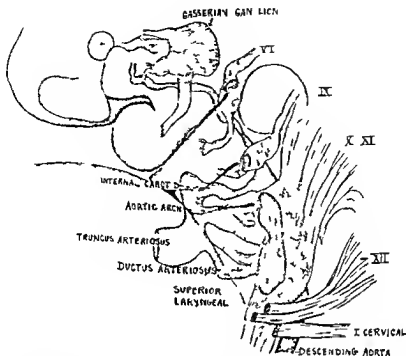


FIG. 3. Lateral view of an 87 millimeter embryo of cow with deep superimposed cross section of the blood vessel and nerves under dissection. (From Fronip drawn by Dr. J. Alonzo.)

the muscular fibers of a fistulous tract being rich in nerve filaments of the glossopharyngeal. Watson in dissecting a cadaver found a complete branchial fistula which intervened between the stylopharyngeus muscle and glossopharyngeal nerve which normally are in close apposition. As it passed behind the fistula the glossopharyngeal gave off several small nerve twigs to its walls. In connection with this it should be noted that most external fistulous openings are along the anterior border of the sternomastoid just above the sternoclavicular junction and as a result contact with the vagus is probable.

The effect of such contact can be appreciated only by a knowledge of the anatomy and physiology of the vagus. In the neck it gives off the superior cardiac branches which arise somewhere between the superior and inferior laryngeal nerves. The inferior cardiac branches arise near the origin of the inferior laryngeal and some of these branches may spring from it. Both superior and inferior

cardiac branches pass toward the heart and unite with the cardiac branches from the sympathetic chain to form the cardiac plexus. The last lies on the arch and the ascending part of the aorta and the inhibitory fibers to the heart have their origin in it. The superior laryngeal nerve sends sensory fibers to the mucous membrane of the larynx. The vagus itself distributes to the lungs two kinds of sensory fibers inspiratory and expiratory, which act normally on the respiratory center. Gastric motility and motility of the small intestine and part of the large intestine are partly governed by vagal action. The pancreas and gastric glands receive secretory fibers from it.

The intimate anatomical relationship that a branchial fistula may assume with respect to the vagus might therefore cause different degrees of irritation. This might further be enhanced by such factors as inflammation, overdistention of the tract with secretion, instrumentation or manipulation. And the

positions with respect to the midline of the neck and second that the internal opening in complete fossa always occurs in the supra-tonsillar fossa as brought out by v. Kostanecki and v. Mikulski in an exhaustive investigation of 125 cases in the literature.

Rabls explanation of the embryological structure is more satisfactory. He pointed out that in the early embryo there are four branchial bars numbered from above down. Each is a protrusion with an ectodermal furrow above and below. These furrows do not normally communicate with the entodermal furrow, which springs from the pharynx. The subsequent development of the mesoderm in the pouches and its circular segmentation produce the branchial arches. The two sides of the first or mandibular arch meet to form the mandible. The second or hyoid arch grows downward and in front rapidly invading the entire future cervical region. A recess known as the precervical sinus which develops from the overgrowth of the second branchial arch accompanied by the atrophy and posterior displacement of the two arches below is normally obliterated. The potential space which occurs from the apposition of ectoderm against ectoderm is obliterated by a disintegration of its cells. The furrow beneath the second branchial arch which is very deep at its posterior end persists longer than the other transitory conditions. The future site of the tonsil is at the internal invagination of the entoderm and is on the same level as the second furrow. Normally in a mammal there is no such final communication at this point between ectoderm and entoderm as exists in the fish where such communication produces the gill cleft. The third and fourth furrows gradually become stretched out and flattened the third becoming the thymus. The fourth is separated from the entoderm by a very thick layer of mesoderm and a break into the precervical sinus at this point is hardly probable. It is accordingly evident that the level of the second furrow is the logical point at which a fistula may enter into the pharynx.

All the following types of branchial abnormalities become readily understandable.

1 The external opening may be high or low in the neck depending on the downward

extent of the growth of the second branchial arch (hyoid arch). In no case would it be above the structures derived from the hyoid arch or below the sternoclavicular junction. The invagination or evagination of the arch determines the external opening with respect to the midline.

2 The blind end of an incomplete external fistula is a continuation of the vestigial remains of the ectoderm of the precervical sinus.

3 If the second arch obliterates the precervical sinus but the second furrow persists and communicates with the pharyngeal entoderm an incomplete internal fistula results.

4 A cessation of complete downward growth of the second arch accompanied by a break through the mesoderm at the level of the second furrow will produce a complete branchial fistula.

5 If both internal and external openings are lacking and the precervical sinus has not been completely obliterated a branchial cyst will result which because of its epithelial structure may give rise to a branchial dermoid or carcinoma.

Figure 2 illustrates how an irregular development of the second arch results in a continuance of the precervical sinus which is normally obliterated. This produces various abnormalities ranging from fistula and cyst to monstrosities.

The relation of the various nerves to the arches must now be considered (see Fig 3 an 87 millimeter embryo of a cow). The facial nerve is distributed along the inferior border of the first arch and the superior border of the second. The glossopharyngeal nerve courses along the inferior border of the second and the superior border of the third arches (Huxley). The superior laryngeal branch of the vagus supplies the fourth arch and the vagus itself passes behind this arch to descend into the thorax (Quenu).

By reason of their location these nerves especially the ninth and tenth may be affected by irritation from inflammatory changes in the tract undue pressure from retained secretion or sudden pressure produced by an instrument. It is also possible that these nerves might send aberrant branches to the wall of the tract. Thus Tournoux speaks of

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selective vagal fibers which are affected would produce symptoms such as cough, hoarseness, acceleration of the pulse, extra systoles, alteration of cardiac force or gastro-intestinal symptoms.

Interesting observations are recorded in the literature of branchial fistula in which some symptoms are clearly those of vagus nerve irritation. Dzondi attributed hoarseness and cough in one of his cases to a communication of the tract with the trachea. We know now that this communication does not occur for the respiratory bud comes off below the branchial apparatus. Heusinger gives a vivid description of the symptoms in the following case. The patient, a girl of 7, had a tract opening at the anterior border of the sternomastoid. The introduction of a probe for a short distance produced a hacking cough. A thick moustache hair 8 centimeters long when inserted into the tract promptly caused a short cough and hoarseness and prevented the child from speaking loudly. These symptoms disappeared immediately on withdrawal of the hair. Heusinger assumed that the hair had gone into the pharynx. But that would not produce hoarseness. All the above symptoms can be satisfactorily explained by irritation of the fibers of the superior laryngeal. In another of Heusinger's cases he injected sugar solution into the tract and attributed the resultant short cough to an inner opening. Favier, in the case of an adult male, made some interesting observations. By probing the branchial fistula or by pinching the tract with the fingers he caused pallor, sweating and an intermittent pulse. As the tract was manipulated an unproductive cough of varying severity resulted. The gentlest kind of probing, although painless, also produced a cough which was accompanied by faintness. An injection of a quinine solution failed to show an internal opening. The pain in the ear in this case was probably caused by referred pain along the auricular sensory branch of the vagus which supplies the external auditory canal. Donon states that if the tract is explored or fluid injected into it there may be cough, tickling in the throat, hoarseness, aphonia or fainting. These phenomena disappear when manipulation is stopped. He

attributes these symptoms to involvement of the glossopharyngeal. It would seem however that they are more satisfactorily explained by irritation of the vagus or one of its branches in the neck. On probing the tract in the fourth case that he reports nausea and cough were produced. The opening was at the anterior border of the sternomastoid a little below the hyoid. According to Cusset, the probing of a fistula may give respiratory reflexes such as cough, hoarseness and oppression. His statement that these phenomena occur only when the external opening corresponds to the fourth branchial cleft shows his firm belief in the cleft theory of the origin of branchial fistula.

Of course cough may be produced in complete fistula by a discharge into the pharynx or by the successful probing of the tract. Lillenthal, Whitacre, Whiteford and Vance report this and in the presence of a tangible etiological factor it would be hazardous to ascribe the symptom to vagus irritation. However such irritation may have been present.

#### CONCLUSIONS

1. Embryological facts show that the branchial arches come into relation with the facial and glossopharyngeal nerves and with the vagus and its superior laryngeal branch. The vagus is so situated that it is most likely to come in contact with a branchial fistula. Symptoms may also be produced by an independent nerve supply which the tract wall may receive from the nerve.

2. Probing or pinching a tract or injecting a diagnostic fluid into it have produced irritative vagal symptoms: cough, palpitation, intermittent pulse, hoarseness, pallor and sweating. Referred pain may occur along sensory fibers.

3. The case herewith reported, a five year old boy with a branchial fistula, gave a history of an unproductive cough for 2 years unsuccessfully treated by a tonsillectomy and medical measures. At operation the inflammatory, incomplete external fistulous tract was found adherent to the vagus nerve and after its excision the cough stopped promptly and did not return in a two and a half year follow up.

TABLE I— $\frac{M}{15}$  CITRATE MIXTURE

|         | pH of buff | Number of motile spermatozoa in field |           |   |     | Time on field in seconds |    |    |      |
|---------|------------|---------------------------------------|-----------|---|-----|--------------------------|----|----|------|
|         |            | Flds counted                          | M         | M | Ave | Sperm counted            | M  | M  | A    |
| Case 1  | 4.0<br>3.0 | 3                                     | No motion |   |     | 3                        | 97 | 50 | 78   |
| Case 2  | 4.0<br>3.8 | 3                                     | N mot     |   | 5   | 3                        | 56 | 30 | 47   |
| Case 3  | 4.0<br>3.0 |                                       | N mot     |   |     |                          |    |    |      |
| Case 4  | 4.0<br>3.0 | 3                                     | N mot     |   | 5   | 3                        | 7  | 80 | 96   |
| Case 5  | 4.0<br>3.0 |                                       | N mot     |   |     |                          |    |    |      |
| Average | 4.0<br>3.0 |                                       | 15        |   |     |                          | 96 | 47 | 71.3 |

TABLE II— $\frac{M}{15}$  PHOSPHATE MIXTURE

|         | pH of buff        | Number of motile spermatozoa in field |               |          |               | Time on field in seconds |              |                |                  |
|---------|-------------------|---------------------------------------|---------------|----------|---------------|--------------------------|--------------|----------------|------------------|
|         |                   | Flds counted                          | M             | Min      | A             | Sperm counted            | M            | Min            | Ave              |
| Case 1  | 3.0<br>2.0<br>7.0 | 3<br>3<br>4                           | 1<br>3<br>0   | 4        | 3             | 3<br>3<br>3              | 87<br>37     | 68<br>8        | 77.9             |
| Case 2  | 3.0<br>2.0<br>7.0 | N mot                                 | 3<br>0        | 2        | 4             | 4<br>3                   | 32           | 8<br>3         | 33.63            |
| Case 3  | 5.0<br>2.0<br>7.0 | 3<br>4<br>4                           |               | 1        | 3<br>5<br>3.3 | 4<br>5<br>4              | 85<br>3<br>8 | 67<br>4<br>5   | 77.703           |
| Case 4  | 5.0<br>2.0<br>7.0 | 3<br>4<br>4                           | 2<br>4<br>0   | 1<br>4   | 3<br>5        | 4<br>4<br>3              | 89<br>4      | 50<br>8<br>3   | 74.375           |
| Case 5  | 3.0<br>2.0<br>7.0 | N mot                                 | 4<br>5<br>6   | 1<br>3   | 2<br>5.3      | 3<br>3                   | 47<br>5      | 5              | 34.10            |
| Average | 3.0<br>2.0<br>7.0 |                                       | 5<br>3<br>5.5 | 3<br>3.5 | 1<br>4.5      |                          | 77<br>34     | 74<br>5<br>6.5 | 75.5<br>9.5<br>3 |

some were actively traversing the field. The rate at which those actively traversing the field progressed was conspicuously different in buffer solutions of different hydrogen ion concentration values. With a stop watch the time required to cross the field for a number of these actively progressing spermatozoa in each preparation was determined and is shown in the tables. The observations were made with a No. 1 ocular and 4 millimeter objective (B and L).

The buffer solutions used were prepared according to the directions given by Clark (2). We used the following Soerensen buffers:  $\frac{M}{15}$  citrate (pH=4.0 to 6.7),  $\frac{M}{15}$  phosphate (pH=5.2 to 7.9), and  $\frac{M}{15}$  glycocoll (pH=8.6 to 10.3), the glycocoll solutions being prepared with Pfannenstiehl's glycyl. In addition we used the Walpole  $\frac{M}{5}$  acetate buffers (pH=4.0 to 5.6) and the Clark and Lubs  $\frac{M}{5}$





TABLE V—SUMMARY

| pH        | 5.0 |      | 6.0 |      | 7.0 |      | 8.6 |      | 9.6 |      | 10.3 |      | 11.0 |      |
|-----------|-----|------|-----|------|-----|------|-----|------|-----|------|------|------|------|------|
|           | N   | Time | N   | Time | N   | Time | N   | Time | N   | Time | No   | Time | No   | Time |
| Citrate   | 1   | 72.5 |     |      |     |      |     |      |     |      |      |      |      |      |
| Phosphate |     | 75.5 |     | 90.5 | 4.5 | 8    |     |      |     |      |      |      |      |      |
| Phosphate | 1   | 3    | 3.2 | 60.7 | 7   | 5.7  |     |      |     |      |      |      |      |      |
| Glycerol  |     |      |     |      |     |      | 5.5 | 6.7  | 5.5 | 6.5  | 0    | 8.5  | 1    | 7.0  |
| Average   |     | 9    | 7   | 45   | 3.6 | 8    | 5.5 | 6.7  | 5.5 | 6.5  | 0    | 8.5  | 1    | 71.0 |

TABLE VI

| Buffer pH 4.0 | E for<br>alkalinization | After alkalization |      |
|---------------|-------------------------|--------------------|------|
|               |                         | Number             | Time |
| Acetate       | Immotile                | 5                  | 1    |
| Phthalate     |                         | 4                  | 7    |

Table V and in the graph. Below a hydrogen ion concentration of 6.0 no motion was observed in the spermatozoa. As we progressed toward more alkaline solutions the number of motile spermatozoa and the speed of the most actively motile ones in each preparation increased to a maximum at hydrogen ion concentration values from 8.5 to 9.5. With still more alkaline solutions the motility again diminished.

It has already been noted that Gray was able by alkalization to restore motility to certain marine spermatozoa which had been rendered immotile by acid. To test the possibility of this with human spermatozoa we mixed semen with  $\frac{M}{2}$  acetate  $\frac{M}{2}$  phthalate and  $\frac{M}{2}$  citrate buffer solutions of a hydrogen ion concentration of 4.0 using one part of semen to four of buffer solution. In all of these the motility was checked. After standing a half hour the suspensions were titrated with decinormal solution of sodium hydroxide ( $\frac{N}{10}$  NaOH) until just alkaline to phenolphthalein and the preparation examined under the microscope. Table VI shows that motility was restored to almost maximal degree. Acidity of hydrogen ion concentration = 4.0 for one half hour there

fore inhibits motility but does not destroy the capacity for active motility when proper hydrogen ion concentration is restored.

The extreme susceptibility of human spermatozoa to change in reaction of the surrounding medium must be considered of great importance and even a weakly alkaline medium (pH 7.5) does not permit the spermatozoa to develop their full activity.

In the normal human female the vaginal secretion is acid and the uterine weakly alkaline (Braus 1). The slightest change in the reaction of the uterus toward the acid side due to disease might be a cause of sterility.

#### CONCLUSIONS

1 The influence of the hydrogen ion concentration on the motility of the human spermatozoa has been studied.

2 The optimum lies between the hydrogen ion concentration values of 8.5 and 9.5.

3 Change toward acidity causes inhibition of motility; no motility occurring below hydrogen ion concentration = 6.0. Reactions higher than hydrogen ion concentration = 10.0 also cause inhibition of motility.

4 Spermatozoa made inactive by rendering the medium acid (pH = 4.0) regain their motility after realkalinization.

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## SURGERY, GYNECOLOGY AND OBSTETRICS

TABLE III— $\frac{M}{8}$  PHOSPHATE MIXTURE

|         | pH of buffer      | Number of motile spermatozoa in field |             |        |                 | Time to cross field in seconds |              |              |                |
|---------|-------------------|---------------------------------------|-------------|--------|-----------------|--------------------------------|--------------|--------------|----------------|
|         |                   | Field counted                         | M x         | Min    | Ave             | Spermatozoa counted            | M            | Min          | Ave            |
| Case 1  | 8.0<br>8.0<br>7.9 | 4<br>4                                | 2<br>2      | 3<br>2 | 1<br>4.5<br>1.5 | 5<br>4                         | 5<br>25      | 53           | 55<br>7.5      |
| Case 2  | 8.0<br>8.0<br>7.9 | No motile<br>4                        | 3<br>4      | 2<br>2 | 2<br>2.5<br>2.5 | 3<br>4                         | 7<br>25      | 34<br>3      | 55<br>54<br>6  |
| Case 3  | 8.0<br>8.0<br>7.9 | 4<br>4<br>4                           | 3<br>3      | 2<br>2 | 2<br>2<br>2     | 4<br>4                         | 73<br>35     | 53<br>3      | 63<br>5.5      |
| Case 4  | 8.9<br>8.9<br>7.9 | No motile<br>4                        | 3<br>3      | 2<br>2 | 2<br>2<br>2     | 3<br>4<br>5                    | 8<br>63<br>1 | 75<br>4      | 66<br>5<br>8.5 |
| Case 5  | 8.0<br>8.0<br>7.9 | 3<br>3<br>4                           | 2<br>2<br>2 | 3<br>3 | 2<br>2<br>2     | 5<br>7<br>25                   | 5<br>7<br>25 | 66<br>5<br>5 | 60<br>5<br>7   |
| Average | 8.0<br>8.0<br>7.9 |                                       | 2.5<br>4    | 2<br>2 | 2<br>2<br>2     |                                |              |              |                |

TABLE IV— $\frac{N}{8}$  GLYCOCOLL MIXTURE

|         | pH of buffer             | Number of motile spermatozoa in field |          |          |                   | Time to cross field in seconds |                   |              |                   |
|---------|--------------------------|---------------------------------------|----------|----------|-------------------|--------------------------------|-------------------|--------------|-------------------|
|         |                          | Field counted                         | M x      | Min      | Ave               | Spermatozoa counted            | M                 | Min          | Ave               |
| Case 1  | 8.6<br>8.6<br>8.3<br>8.3 | 4<br>3<br>4<br>4                      | 2<br>2   | 4<br>5   | 2<br>7.5<br>3     | 2<br>2<br>2                    | 8<br>6<br>3<br>3  | 4<br>3<br>27 | 6<br>4.5<br>44    |
| Case 2  | 8.6<br>8.6<br>8.3<br>8.3 | 5<br>4<br>3<br>3                      | 4<br>3   | 4        | 3<br>0            | 5<br>5<br>5<br>4               | 7<br>3<br>33<br>2 | 4<br>3<br>49 | 5.5<br>7.5<br>66  |
| Case 3  | 8.6<br>8.6<br>8.3<br>8.3 | 4<br>4<br>4<br>4                      | 2<br>2   | 3<br>2   | 4                 | 5<br>5<br>5<br>4               | 5<br>7<br>33<br>2 | 5<br>5<br>49 | 6.5<br>7.5<br>1.5 |
| Case 4  | 8.6<br>8.6<br>8.3<br>8.3 | 3<br>4<br>3<br>3                      | 2<br>2   | 4<br>2   | 2<br>2            | 6<br>4<br>4<br>3               | 5<br>5<br>5<br>3  | 6<br>5<br>4  | 5.5<br>5.5<br>0.5 |
| Case 5  | 8.6<br>8.6<br>8.3<br>8.3 | 4<br>4<br>3<br>3                      | 2<br>2   | 5<br>2   | 3.5<br>3.5<br>3.5 | 7<br>5<br>5<br>4               | 8<br>5<br>50      | 5<br>5<br>5  | 5.5<br>5.5<br>37  |
| Average | 8.6<br>8.6<br>8.3<br>8.3 |                                       | 2.5<br>3 | 3.5<br>2 | 3.5<br>2          |                                |                   |              |                   |

phthalate buffers (pH=4.0 to 6.0) and  $\frac{M}{8}$  phosphate buffers (pH=5.8 to 8.0). Buffer solutions containing borate appeared to exert a specific inhibiting action on the motility of the spermatozoa and were therefore not employed. The hydrogen ion concentrations of the buffer solutions were checked by electrometric determinations.

The results of these experiments are shown in Tables I to IV and are summarized in

TABLE I — LESIONS OF THE GALL BLADDER FOUND AT NECROPSY

|                          | Age years |   |    |    |    |    |    |    |    |    |    |    |    |    | T t l | P r cent |
|--------------------------|-----------|---|----|----|----|----|----|----|----|----|----|----|----|----|-------|----------|
|                          | 15        | 5 | 30 | 35 | 40 | 45 | 5  | 55 | 60 | 65 | 7  | 75 | 8  | 85 |       |          |
| Specimens examined       | 65        | 5 | 6  | 10 | 30 | 48 | 58 | 54 | 74 | 8  | 66 | 43 | 3  | 5  | 61    |          |
| Grossly normal           | 6         | 4 |    | 10 | 6  | 15 | 10 |    | 8  | 6  | 4  | 7  |    |    | 235   | 38       |
| Cholesterosis            |           | 1 | 3  | 4  | 5  | 9  | 6  | 5  | 3  | 3  |    |    |    |    | 44    | 7        |
| Papillomatosis           |           | 1 | 3  | 7  | 15 | 4  | 5  | 3  | 7  | 3  | 6  | 7  |    |    | 13    | 21       |
| Stones                   |           |   |    | 6  | 4  | 3  | 4  | 3  | 3  | 4  | 5  | 5  |    |    | 65    | 7        |
| Carcinoma                |           |   | 1  | 5  | 7  | 6  | 9  | 9  | 8  | 3  | 0  | 0  |    |    | 3     | 0        |
|                          |           |   |    |    | 1  |    | 3  | 1  | 1  | 4  | 4  |    |    |    | 4     | 5        |
| Total abnormal specimens | 1         | 1 | 6  | 10 | 31 | 33 | 39 | 34 | 53 | 55 | 5  | 9  | 3  | 4  |       |          |
| P cent                   | 1         | 5 | 5  | 65 | 70 | 68 | 67 | 6  | 7  | 6  | 75 | 67 | 76 | 80 |       |          |

ata and stones and two with papillomatosis and stones

It is evident that "cholesterosis" of the gall bladder is a disease of the adult the greatest percentage occurring at the age of 35 although a surprisingly high percentage occurs in younger persons (Table III). In one instance it was present in a girl of 13 and in 2 other patients under 20. Cholesterosis without any other gross lesion was seen in 131 of 612 adult subjects 21 per cent.

MacCarty (33) in 1919 reported that 18 per cent of 5000 surgically removed gall bladders showed this cholesterol deposit and C H Mayo (39) in 1921 reported 39 per cent of 1254 operative gall bladders with this lesion.

The papillomatous gall bladder is essentially a condition of "cholesterosis" but the picture is somewhat different in that the cholesterol is piled up in localized polypoid areas and for this reason deserves a separate classification. In this series there were 65 instances of papillomatosis of the gall bladder wall in six instances diffuse "cholesterosis" was also present so that 196 patients had gross evidence of disturbed lipid mechanism alone in the gall bladder wall 31 per cent.

TABLE II — MINOR GROSS LESIONS OF THE GALL BLADDER FOUND AT NECROPSY

|   | Case |
|---|------|
| Adhesion to colon (with fistula)                          | 7    |
| Adhesion to duodenum (with fistula)                       | 9    |
| Adhesion to the stomach (with fistula and abdominal wall) | 1    |
| Mucoid fibrous tissue                                     |      |
| Polypoid without stones                                   |      |
| Simple non-cholesterosis polyp                            |      |
| Adenoma   |      |
| Atypical glandular tissue                                 | 7    |
| T total   | 69   |

Forty-four (73 per cent) occurred dependent on the pathological changes in the gall bladder

In 1915 C H Mayo (38) reported 107 of 2538 4.2 per cent surgically removed gall bladders with this lesion and MacCarty (33) in 1919 reported 4 per cent of 5000 surgically removed gall bladders.

TABLE III — LIPOID CHANGES FOUND IN THE GALL BLADDER AT NECROPSY

| Cases examined | Age years | Cholesterol   | Papillomatosis | Total | Percent     |
|----------------|-----------|---------------|----------------|-------|-------------|
| 63             | 5         | 1             |                | 4     | 5           |
| 5              | 5         | 3             |                | 13    | 44          |
| 6              | 5         | 3             | 6              | 9     | 45          |
| 39             | 35        | 4             |                | 9     | 45          |
| 48             | 4         | 4             | 4              | 8     | 33          |
| 55             | 45        | 5             | 4              | 9     | 37          |
| 54             | 50        | 3             | 3              | 6     | 33          |
| 74             | 55        | 7             |                | 9     | 39          |
| 8              | 6         | 4             |                | 4     | 9           |
| 66             | 65        | 9             | 4              | 3     | 34          |
| 43             | 7         | 6             | 3              | 3     | 5           |
| 3              | 75        | 7             | 3              | 2     | 4           |
|                | 6         | 2             |                |       | not         |
| 5              | 85        |               |                |       | total       |
| 6              |           | (34 per cent) | (65 per cent)  | 207   | 33 per cent |

TABLE IV — LIPOID CHANGES

| MacCarty<br>lipoid | Cholesterolosis | Papillomatosis |
|--------------------|-----------------|----------------|
| Gross              | 5               | 20             |
| Gross              | 43              | 5              |
| Gross              | 5               | 7              |
| Grade 4            | 4               | 4              |

The microscopic picture of lipid as seen in cholesterosis of the gall bladder has been fully described by MacCarty and McGrath (34) Corkery (10) Boyd (8) Aschoff (4) Aschoff and Brämeister (5) Stewart (6) and others. The picture in this series does not differ materially (Table IV) except that early cytolytic changes occur in the postmortem specimen. These changes were fully discussed

# A CLINICAL AND PATHOLOGIC STUDY OF CHOLECYSTITIS AND CHOLELITHIASIS<sup>1</sup>

By STANLEY H. MENTZER, M.D., FOCKESTER, MINNESOTA  
Fell. w. S. S. S. The Mayo Foundation

## INCIDENCE OF GALL BLADDER DISEASE AMONG NECROPSY CASES

AMONG 612 specimens examined post mortem, 377, 62 per cent, showed grossly visible diseases of the gall bladder. If young persons are omitted this would indicate that 66 per cent of all those more than 21 years of age who come to necropsy have gall bladder disease. No higher incidence of gall bladder disease discovered at necropsy appears in the literature, probably because a relatively high percentage of patients with gall bladder disease register at the Mayo Clinic. Among 49,659 new patients registering at the clinic during 1927, 2,475, 5 per cent, complained of gall bladder disease and 1,075 operations were performed for gall bladder disease during that year.

Hoffman, statistician for the Prudential Life Insurance Company, computed that 2,887 persons in a total of 85,147,822 died from gall bladder disease in 1919; that is, 33 out of every 1,000,000 of the population. Riedel reported that only 5 per cent of 2,000,000 persons had gall bladder disease. Lichty found that 40 per cent of 1,500 patients with gastro-intestinal complaints had disease of the gall bladder or appendix.

In this series of consecutive deaths at the Mayo Clinic, however, less than 8 per cent (49) were due primarily to gall bladder disease. Forty-six of the patients had had operations, 35 of these had had stones. The three patients without operations did not have stones.

The majority of persons more than 30 years of age showed some disease of the gall bladder. The youngest patient was a girl of 13 who had grossly visible lipoid in the wall of the gall bladder (Table I).

## MINOR GROSS LESIONS

In this series of necropsy examinations at the Mayo Clinic there were no instances of

congenital absence of the gall bladder, but at a previous examination here Nagel found one case, that of a man aged 38. Meckel in 1912 stated that congenital absence of the gall bladder was not so rare. Gay in 1922 collected a total of 22 cases. None has been reported since. In this series there were no instances of congenital absence, atresia or reduplication of the bile ducts, but numerous instances of each are reported in the literature. The incidence of minor gross lesions was 8 per cent (Table II).

Among 727 patients operated on for gall bladder disease, Blalock found 0.2 per cent with diverticula of the gall bladder.

Among 235 macroscopically "negative" gall bladders there were 86 with microscopic evidence of inflammatory change indicated by polyps. In 34 of these there were abnormal numbers of polymorphonuclear cells in the gall bladder wall, inflammatory changes were of grades 2 and 3, especially. Adding this group to the list of gall bladders with gross disease gives a total of 463 diseased gall bladders (75.65 per cent of the total necropsy series).

## LIPOID CHANGES

Metabolic disturbances in the lipoid mechanism of the gall bladder wall occur in about 38 per cent of the adult population.

Table II shows that "cholesterosis" occurred alone in 21 per cent of the cases and papillomatosis alone in 11 per cent. Papillomatous lesions were superimposed on an additional 5.6 per cent of "cholesterosis" cases. And "cholesterosis" occurred in association with gall stones in 2.4 per cent of cases. So that approximately 40 per cent of the necropsy series showed visible lipoid ("cholesterosis") in the gall bladder wall.

Among 37 gall bladders removed at operation, 13 showed cholesterosis alone, 18 in association with gall stones, 4 with papilloma.

<sup>1</sup> Abstr. of thesis submitted to the Faculty of the Graduate School of the University of Minnesota for the degree of M.D. in 1928. This is a fulfillment of the requirements for the degree of M.D. in the School of Surgery, M.D. 1928.



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Table III shows that cholesterosis occurred alone in 21 per cent of the cases and papillomatosis alone in 11 per cent. P-pillomatous lesions were superimposed on an additional 56 per cent of 'cholesterosis' cases. And cholesterosis occurred in association with gall stones in 24 per cent of cases. So that approximately 40 per cent of the necropsy series showed visible lipoid ('cholesterosis') in the gall bladder wall.

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were almost equally divided (62 males 61 females) but the percentage figures for the total number of males and females gave the female proportion a greater incidence of stones 16.75 per cent males and 28.18 per

TABLE VI — INCIDENCE OF CASES OF GALL STONES

| Author and locality       | Cases<br>mentioned | Percent | Fitted           |
|---------------------------|--------------------|---------|------------------|
| Mitchell, Norway          |                    |         | Necropsy         |
| Mitchell, Chacar          | 60                 | 3       | Necropsy         |
| Miyoshi, J                | Men                | 40      |                  |
|                           | Women              | 80      |                  |
| For Kol                   |                    | 50      | Necr pay         |
| Rother, Munich            |                    | 60      | Necr pay         |
| P. for Dresden            |                    | 70      | Necr pay         |
| Miyoshi C. H. Mays Clinic |                    | 71      | Pl. the opt. too |
| Schwab, Erlangen          | 123                | 7       | Necr opay        |
| Mitchell, Munich and      |                    |         |                  |
| Erlangen                  |                    |         |                  |
| Möller, John Hopkins      | 9074               | 78      | Necr pay         |
| Barbara                   |                    | 785     | Necr pay         |
| Winters, California       |                    | 797     | Necr pay         |
| Mayer, Germany            |                    | 5 to 12 | Necropsy         |
| Mitchell, B. Sel          |                    |         | Necropsy         |
| P. for                    | 65                 | 27      | N. cropay        |
| Rover, Copenhagen         | 54                 | 18      | Laps. t. my      |
| R. H. B. Sel              | 7447               | 81      | Necr pay         |
| Frank, J. naa             |                    | 109     | Necropsy         |
| Schwarz, Strasbourg       |                    |         | Necropsy         |
| MacCall, Sweden           |                    | 0       | Necr pay         |
| W. Gerny, Germany         |                    | 66      | Necr pay         |
|                           | Men                | 44      | Necr pay         |
| H. Klose, and Bismarck    |                    |         |                  |
| M. Stead, M. y. Clinic    | 224                | 46 to 5 | Necr pay         |
|                           | Men                | 61      | Necr pay         |
|                           | Women              | 8       |                  |

TABLE VII — INCIDENCE OF CASES OF GALL  
STONES BY HEMIDECADES

| Age years           | 5 | 3 | 35 | 4  | 45 | 5  | 55 |
|---------------------|---|---|----|----|----|----|----|
| Cases with tons     |   |   |    |    |    |    |    |
| Total cases         | 9 | 3 | 7  | 6  |    | 0  | 0  |
| Percentage of total |   | 3 | 4  | 45 | 50 | 59 | 78 |
| Copy by sex         | 5 |   | 7  | 5  | 6  | 6  | 4  |

cent females. The age incidence in cases of gall stones is shown in Tables VII and VIII. The youngest in this series was a man aged 23 years.

Richter has reported the largest stone yet found. It weighed 3 ounces and 5 drams (112 grams). The greatest number of stones so far reported is 7 000 reported by Otto in 1863. Vachel and Stevens have reported the greatest number of actual stones in the bahr

ducts 520 stones in the hepatic ducts weighing 1378 grams. The incidence of the different types of stones in my series is shown in Table IX.

Table V shows the incidence of "white bile" as reported by various authors.

In the group of single cholesterol stones and in the group of cholesterol rich stones with an indefinite history of gastric distress the inflammatory stigmas in the gall bladder wall were not so marked as in the group of common stones. Indeed in several instances of cholesterol stones the gall bladder wall was extremely thin and often showed little microscopic evidence of inflammatory change. Especially was this true in the cases with pure cholesterol stones or cholesterol rich stones.

TABLE VIII—GALL STONES IN THE YOUNG

| A t h r     | C s e  | F c r n l | A g                       |
|-------------|--------|-----------|---------------------------|
| K l i g g   | 5      |           | E i g h t m o n t h f t   |
| A h t a     | 5      |           | N e w b o n m o n t h     |
| F i e       | 5      |           | L d t y e r s             |
| h i g g     | (5 t ) |           | G l i n d l e y           |
| A h i g g   | 44     |           | L d f i l t y s           |
| K y         |        | o 75      | L d t e t y y             |
| H a r l y   |        |           | L d t t y y e a r s       |
| B l o c k   |        | 5         | L d t w t y y r s         |
| M y o C h n |        |           | Y u n g s t a g e d t t y |
|             |        |           | t h y e a                 |

TABLE IV — GALL STONES

|                                 | C               |
|---------------------------------|-----------------|
| F                               | 45              |
| R m d lscrh                     | 0               |
| R m d M                         | 38              |
| Re-operated M y Clinic          | 8               |
| F und t ec psy                  | 84              |
| gl h l t in t                   | 8               |
| Multipl h l t in t              | 8               |
| S gl commo                      | 8               |
| Multipl commo                   | 55              |
| Bilrubin-calc m tom             | 7               |
| T l                             | 3               |
| S d w s f o u n d i n g a s e d | ( 6 ) r e c t ) |

TABLE V — WHITE BILE (KAUSCH)

| A th            | Oper t                      | C se | White b l |     |
|-----------------|-----------------------------|------|-----------|-----|
|                 |                             |      | C se      | P t |
| Case J dd       | G B bladder<br>C rano h pat | 638  | 5         | 79  |
| Bl lock         | F d t es                    | 640  | 10        | 9   |
| M y Clinic sp 4 | F g l t es                  | 403  | 4         | 0   |
|                 |                             | 3    | 9         | 7   |

|        |        |
|--------|--------|
| T t    | liters |
| T sc   | 5      |
| E dman | 8      |



previously (44). In 46 of 477 cases in which both Sudan III and Lorrain Smith's Nile blue sulphate stains were used lipoid was visible microscopically whereas it was not macroscopically. Boyd (9) in an analysis of 100 gall bladders surgically removed found 10 with grossly visible fat and 52 with microscopic lipoid.

It was previously suggested that 'cholesterosis' of the gall bladder is but a single and localized instance of metabolic fat disturbance occurring throughout the rest of the body (42, 43). It is a well established fact that pregnancy and obesity are often precursors of disease of the gall bladder. In these two conditions there is a manifest derangement in the fat balance in the body. That 'cholesterosis' is the principal gall bladder disease occurring with obesity and pregnancy has not been suggested by other authors.

Among 110 women who had been pregnant and had gall bladder disease 64 per cent showed 'cholesterosis' of the gall bladder and the total percentage of gall bladder lesions in parturient women is 82. Of 34 patients weighing over 210 pounds and having gall bladder disease 70 per cent showed 'cholesterosis'.

In a study of microscopic fat in the liver 41 per cent of the livers not associated with 'cholesterosis' of the gall bladder revealed lipoid, whereas 48 per cent of those associated with 'cholesterosis' of the gall bladder revealed it. This meager difference seems of little significance but the much severer grade of replacement of fat in the latter group is of considerable moment.

That 'cholesterosis' of the gall bladder is essentially a non-inflammatory lesion is fairly well recognized (Table V). Indeed I have produced the microscopic picture of this condition experimentally in the dog in the absence of inflammatory changes (42). Surgeons the world over have noted the very thin wall of the "strawberry" gall bladder indeed this wall is often so thin that the cholesterin markings may be seen through the serosa.

Furthermore the periductal leucocytic infiltration in the liver in cases of "cholesterosis" and pylopomatosis is far less than in those of

any other gall bladder lesion and less even than the percentage involvement in the "negative" gall bladder group as is shown later.

TABLE V.—INFLAMMATORY CHANGES IN THE WALL OF THE GALL BLADDER

|  | Grossly inflamed wall of gall bladder | Grossly inflamed wall of gall bladder |            |               |    |     | Grossly inflamed wall of gall bladder |
|--|---------------------------------------|---------------------------------------|------------|---------------|----|-----|---------------------------------------|
|  |                                       | P                                     | Papillitis | Cholecystitis | T  | Per |                                       |
| Leucocyte infiltration (in Leucocyte infiltration)     | 9                                     | 30                                    | 5          | 7             | 53 | 3   | 9                                     |
| Lymphocyte infiltration (in Lymphocyte infiltration)   | 0                                     | 6                                     | 5          | 5             | 1  | 8   |                                       |
| (50 c)   |                                       |                                       |            |               |    |     |                                       |
| Lymphocytes infiltration (in Lymphocytes infiltration) | 49                                    | 51                                    | 5          | 1             | 34 | 55  | 0                                     |
| (10 c)   |                                       |                                       |            |               |    |     |                                       |
| Lymphocytes infiltration (in Lymphocytes infiltration) | 47                                    | 17                                    | 0          | 1             | 6  | 7   |                                       |
| (1 c)  |                                       |                                       |            |               |    |     |                                       |
| Lymphocytes infiltration (in Lymphocytes infiltration) |                                       |                                       |            |               |    |     | 11                                    |
| Lymphocytes infiltration (in Lymphocytes infiltration) | 8                                     | 5                                     | 3          | 3             | 1  | 8   | 23                                    |
| Lymphocytes infiltration (in Lymphocytes infiltration) | 3                                     | 16                                    | 22         | 10            | 48 | 1   |                                       |
| Lymphocytes infiltration (in Lymphocytes infiltration) |                                       |                                       |            |               |    |     |                                       |
| Lymphocytes infiltration (in Lymphocytes infiltration) | 13                                    | 5                                     | 5          | 4             | 1  | 1   | 3                                     |

This relationship is likewise evident in the comparison tables of inflammatory changes in the appendix in cases of gall stones and of 'cholesterosis'.

#### GALL STONES

Gall stones were found in 123 of the 612 postmortem specimens 20 per cent.

None however was seen in person under 21 years thus raising the percentage figure to more than 1 per cent of the adults. Also there were gall stones in 11 cases of malignant disease involving the gall bladder. Table VI gives the incidence of gall stones as recorded by various authors and in different countries.

In the Copenhagen series from 495 to 19 per cent of males were afflicted with gall stones and from 11.27 to 31 per cent of females. In the Johns Hopkins series of gall stone cases 8 per cent of the patients were males and 72 per cent females. Eusterman (11) reported that 76 per cent of 9115 gall stone cases were in females. Miyake reported that only 3 per cent of Japanese women have stones. Alvarez, Meyer, Rusk, Taylor and Gaston report that of 60 cases of gall bladder disease 33 per cent had stones 19 were in men and 41 in women. In my series the sex

bladder disease. Their observations have been repeatedly verified (Table VIII). Recently

TABLE XIII.—INCIDENCE OF TYPHOID FEVER  
WITH DISEASE OF THE GALL BLADDER  
(611 Necropsies)

|                               | Cases | Per cent |
|-------------------------------|-------|----------|
| Vegetative & flaccid          | 0     | 0.0      |
| Disease of the gall bladder   | 88    | 23.3     |
| Gall stones                   | 5     |          |
| Cholesterosis                 | 5     |          |
| Minor grossly visible lesions |       |          |

Blalock found that typhoid had been a precursor in 28 per cent of gall bladder cases. Alvarez obtained a history of typhoid in only 7 of 60 cases of gall bladder disease, and Reid and Montgomery have collected but 28 cases of acute cholecystitis complicating typhoid fever.

In this series the females with gall bladder disease do not predominate in the usual proportion for 57 per cent of the total males had gall bladder disease and 64 per cent of the total females (Table XIV)

TABLE XIV—SEX INCIDENCE IN CASES OF  
DISEASE OF THE GALL BLADDER

|  | Miles | F cent<br>f total | F m i s | F cent<br>f total |
|--|-------|-------------------|---------|-------------------|
| Gross gall bladder tissue & (un<br>cluding carcass mass) | 33    | 65                | 3       | 736               |
| Cholesterol  | 87    | 33.7              | 44      | 36                |
| Phospholipids  | 42    |                   |         |                   |
| Protein  | 6     | 675               | 61      | 8                 |
| Total  | 3     | 56.9              | 545     | 63.96             |

The cases of gall stones are almost equally divided between the sexes but the proportion of males and females so afflicted is quite different. On the other hand the proportion of 'cholesterosis' and papillomatosis of the gall bladder wall is greater in the male than in the female.

RELATION OF PREGNANCY TO DISEASE OF THE  
GALL BLADDER

Huchard in 1882 was the first to note the relation of gall bladder disease to pregnancy. Since that time many observations have been made verifying his opinion. At present the literature emphasizes the association of hypercholesterinaemia and gall bladder disease with pregnancy. Osler stated that 90 per cent of

women who had gall stones had borne children and this observation has been repeatedly verified to a greater or less degree. In this series of 134 women with gall bladder disease 110 had been pregnant one or more times 8.

TABLE XV—NUMBER OF PREGNANCIES AND THE TYPE OF ASSOCIATED DISEASE OF THE GALL BLADDER

|                               | N<br>n           | P<br>p             | g<br>g           | cc<br>cc | P<br>P           | P<br>P           | Pa<br>m<br>lt<br>pa | P<br>tot<br>l    |
|-------------------------------|------------------|--------------------|------------------|----------|------------------|------------------|---------------------|------------------|
| G<br>l<br>ca<br>Ch<br>P<br>St | 4<br>8<br>4<br>8 | 8<br>10<br>13<br>5 | 1<br>3<br>3<br>7 |          | 5<br>0<br>3<br>0 | 5<br>5<br>4<br>8 | 8<br>10<br>6<br>5   | 8<br>5<br>7<br>5 |
| Total                         | 4                |                    |                  |          | 10               | (52.00 per cent) |                     |                  |

per cent (Table V) Alvarez however found that of 41 women with gall bladder disease 17 had had no children, 41 per cent

### RELATION OF OBESITY TO DISEASE OF THE GALL BLADDER

That obesity has likewise been associated with gall bladder disease has long been observed. In this series 44 of the patients weighed more than 110 pounds, 34 of these, 77 per cent had some lesion of the gall bladder (39 per cent with stones, 38 per cent with cholesterosis) and 10 had no lesion of the gall bladder. From Table XVI it is evident

TABLE XVI—RELATION OF OBESITY TO INCIDENCE OF DISEASE OF THE GALL BLADDER

|                                       |  | Weight, pounds |    |    |    |    |     |     |     |     |     |     |
|---------------------------------------|--|----------------|----|----|----|----|-----|-----|-----|-----|-----|-----|
|                                       |  | Below 1        | 1  | 40 | 6  | 80 | 100 | 140 | 160 | 250 | 300 | 600 |
| Gross lessons:                        |  |                |    |    |    |    |     |     |     |     |     |     |
| Ch less on                            |  | 7              | 4  | 4  | 7  | 8  | 4   | 1   |     |     |     |     |
| P pull m                              |  | 5              | 6  | 7  | 8  | 3  | 5   | 4   |     |     |     |     |
| St                                    |  | 1              | 7  | 3  | 3  | 9  | 4   |     |     |     |     |     |
| Total                                 |  | 25             | 33 |    | 23 | 54 | 35  | 6   | 3   | 1   |     |     |
| C with th d                           |  |                |    |    |    |    |     |     |     |     |     |     |
| with th d                             |  |                |    |    |    |    |     |     |     |     |     |     |
| dis th g l                            |  |                |    |    |    |    |     |     |     |     |     |     |
| th bladd                              |  | 7              | 29 | 63 | 1  | 76 | 44  | 13  | 4   | 1   | 2   | 1   |
| Percent g with th d so f th g l bladd |  |                |    |    |    |    |     |     |     |     |     |     |
|                                       |  | 20             | 59 | 56 | 3  | 69 | 67  | 70  | 45  | 1   | 75  | 100 |

(mulberry stones, gooseberry stones jack stones or cholesterol rich common stones) in which there was an evident history of intermittent hypercholesterolemia particularly in association with pregnancy. Here the clinical and pathological pictures strongly suggest the metabolic origin of gall stones for inflammatory stigmas are often meager. In 36 of 41 cases 87 per cent of cholesterol rich stones the leucocytic and lymphocytic involvement of the gall bladder wall was graded below 2, whereas in an equal number of cases of dark common stones 29 71 per cent were graded above 3.

In the group of cases with cholesterol rich stones the gall bladder wall almost universally contained a high degree of microscopic lipid whereas in the majority of the cases of common stone especially dark stones and bilirubin calcium stones there was no microscopic fat in the mucosa or stroma.

#### CARCINOMA OF THE GALL BLADDER

Carcinoma involving the gall bladder was found in 14 cases 2.28 per cent. Three were primarily pancreatic 10 were very probably primary in the gall bladder and 1 was indeterminate. Of the 10 3 were carcinoma simplex and seven adenocarcinoma. Thus in 1.63 per cent of the entire series the carcinoma was primary in the gall bladder. Table VI gives the percentage of carcinoma of the gall bladder found in various series of gall bladder cases.

The age incidence in cases of carcinoma of the gall bladder is rather high. In my series the greatest number of cases was found at the age of 60, the youngest was 33 and the oldest 7. The youngest case reported is that of Maxon in a boy of 4. Erdmann reports a case in a boy of 15.

The occurrence of gall stones with biliary malignant disease is very variable as recorded in the literature from 100 (Janowski) to 69 per cent (Musser). In all of my 14 cases of malignant disease of the gall bladder gall stones were associated. In 10 definite cases of primary carcinoma of the gall bladder 6 were in males and 4 in females.

Sarcoma of the gall bladder is not so common only 18 cases having been recorded to

date. In this series only 1 case of primary sarcoma of the gall bladder was found.

#### HISTORY AND SYMPTOMS

A positive history indicating gall stones was obtained in only 50 per cent of the cases with gall stones for among 123 cases of gall stones, only 61 afforded a positive history of

TABLE VI — CARCINOMA OF THE GALL BLADDER

| A thor ad p l c e  | Case | P | 1 | F and at   |
|--------------------|------|---|---|------------|
| F. Swett & d. Ripp | 50   | 1 | 0 | Nec. per   |
| E. d. m. m.        | 15   | 1 | 0 | Oper. post |
| At. Loebing        |      | 0 | 1 | Necropsy   |
| Erdmann            | 101  | 0 | 1 | Oper. post |
| Kaufmann           | 106  | 1 | 0 | Necropsy   |
| At. Basel          |      | 1 | 1 | Necropsy   |
| At. Bresla         |      | 1 | 0 | Necropsy   |
| M. J. W. J.        | 30   | 3 | 0 | Oper. post |
| Bl. lock           | 233  | 4 | 0 | Oper. post |
| Sm. (Hess)         | 1    | 0 | 1 | Oper. post |
| Dickert            | 10   | 1 | 0 | Oper. post |
| De. ver            | 1    | 0 | 1 | Oper. post |
| M. (Hess)          | 1    | 0 | 1 | Oper. post |
| M. (Hess)          | 1    | 0 | 1 | Oper. post |
| M. (Hess)          | 1    | 0 | 1 | Oper. post |

gall stone colic in 58 of these operation had been performed. A suggestive history of disease of the gall bladder was obtained in 5 others 2 per cent. But a very positive history of colic and the usual syndrome of flatulence belching and qualitative food distress was obtained in 2 cases in which 'cholesterol' alone was found. Negative histories were obtained in a relatively high percentage of cases (Table VII).

It has been said that 'silent' gall stones are a myth. This is indeed probably quite

TABLE VII — NEGATIVE GASTRIC HISTORY IN CASES OF DISEASE OF THE GALL BLADDER

| Case      | P | 1 |
|-----------|---|---|
| Cy. 1     | 1 | 0 |
| P. (Hess) | 1 | 0 |
| Cy. 1     | 1 | 0 |
| Cy. 1     | 1 | 0 |
| Cy. 1     | 1 | 0 |
| Cy. 1     | 1 | 0 |
| Cy. 1     | 1 | 0 |
| Cy. 1     | 1 | 0 |
| Cy. 1     | 1 | 0 |
| Cy. 1     | 1 | 0 |

true but these data show how difficult it is to obtain a reliable history.

#### RELATION OF TYPHOID FEVER TO DISEASE OF THE GALL BLADDER

The early pathologists were the first to note the relation of typhoid fever to gall

TABLE XIX — APPENDICEAL DISEASE IN ASSOCIATION WITH DISEASE OF THE GALL BLADDER OR PEPTIC ULCER\*

|                            | With lesions of the gall bladder | With lesions | With lesions | With lesions |
|----------------------------|----------------------------------|--------------|--------------|--------------|
| Adjacent appendix          | 4                                | 7            | 5            | 5            |
| Distended                  | 34                               | 5            | 7            | 7            |
| Both adherent and enlarged | 34                               | 5            | 21           | 4            |
| Surprisingly removed       | 33                               | 5            | 0            | 5            |
| Total                      | 103                              | 33           | 95           | 6            |
| Per cent                   | 46.3                             | 9.37         | 6.9          | 7.37         |

\*73 per cent of appendiceal cases had associated gall bladder disease.

Let It has long been known that inflammatory changes occur in the liver in a high percentage of cases when there is disease of the gall bladder.

Riedel in 1888 first described the tongue like projection of the liver in cases of hepatitis and Naunyn in 1892 noted the general enlargement of the liver in gall bladder disease. Langenbach, Fink and Mayo Robson soon corroborated their observations. Grube and Graff have described hepatitis almost invariably with gall bladder disease.

TABLE XX — PEPTIC ULCER IN ASSOCIATION WITH LESIONS OF THE GALL BLADDER OR APPENDIX\*

|                  | With lesions of the gall bladder | With lesions of the appendix | With lesions | With lesions |
|------------------|----------------------------------|------------------------------|--------------|--------------|
| Gastric Duodenal | 16                               | 1                            | 5            | 9            |
| Total            | 44                               | 33                           | 9            | 6            |
| Per cent         | 7.8                              | 8                            |              | 39           |

In 83 per cent of cases the associated disease is in the gall bladder.

TABLE XXI — INCIDENCE OF PEPTIC ULCER AND LESIONS OF THE APPENDIX WITH DISEASE OF THE GALL BLADDER

|                                    | Associated lesions of the appendix | Associated lesions of the appendix | Associated lesions of the appendix |
|------------------------------------|------------------------------------|------------------------------------|------------------------------------|
| Associated lesions of the appendix | 63                                 | 46                                 | 58                                 |
| Associated lesions of the appendix | 44                                 | 70                                 |                                    |
| Total associated lesions           | 256                                | 79                                 | 64                                 |

Peterman, Priest and Graham state that in 1917 in 87 per cent of their 30 operative gall bladder cases there was enlargement of the

liver. Kehr (27, 28, 29) found hepatic enlargement in only 15 to 20 per cent of his cases of cholecystitis. MacCarty (32) found hepatitis in 81 per cent of the cases of cholecystitis and Weble in 60 per cent of 46 cases of cholecystitis. Most of the observers have taken sections of the liver adjacent to the operative site, namely the edge of the liver close to the site of the gall bladder. Tietze and Winkler however in 50 cases of cholelithiasis found evidence of inflammatory changes in the liver in almost every case even in sections taken from the dome of the right lobe of the liver opposite the gall bladder.

In my studies sections were taken from at least three localities in the liver adjacent to the gall bladder from the dome of the right lobe of the liver and from the dome of the left lobe of the liver. It is evident at once, that there is a marked variation in the microscopic picture dependent on the site of excision of the specimen. As a rule in this series the liver almost always showed varying degrees of hepatitis in the sections from tissue adjacent to the gall bladder whereas many of the sections from the dome of the left lobe of the liver even in cases of severe cholecystitis with cholelithiasis showed no comparable evidence of inflammatory change.

Among 548 postmortem cases with full records and a careful gross description of the liver microscopic sections were made in all but 62 cases. The microscopic findings are given in Table XXII.

It will be seen from Table XXII that the liver was involved in inflammatory lesions in

TABLE XXII — INCIDENCE OF HEPATIC DISEASE ASSOCIATED WITH DISEASE OF THE GALL BLADDER

|   | Lymphocytes | d polymorph | leucocytes |          |
|---|-------------|-------------|------------|----------|
|   | Total       | Per cent    | Per cent   | Per cent |
| With lesions of the gall bladder                      | 12          | 4           | 21         | 64       |
| With gross lesions of the gall bladder (in 100 cases) | 5           | 9           | 17.6       | 23       |
| With lesions of the gall bladder                      | 9           | 7           | 9.9        | 32       |
| With lesions of the gall bladder                      | 55          | 1           |            | 6        |
| With lesions of the gall bladder                      | 99          | 35          | 31         | 71       |

that the proportion of diseased gall bladders increases with increase in body weight

TABLE XVII — DISEASE OF THE GALL BLADDER WITH ASSOCIATED APPENDICEAL DISEASE OR PEPTIC ULCER\*

|                          | Gross lesions | Cholecystitis | Peptic ulcer associated | Stomach | Crohn's disease | Total |
|--------------------------|---------------|---------------|-------------------------|---------|-----------------|-------|
| Appendiceal lesions in   | 5             | 63            |                         | 5       | 4               | 65    |
| Appendiceal lesions with |               |               |                         |         |                 |       |
| peptic ulcer             | 4             | 32            |                         | 18      | 4               | 70    |
| Peptic ulcer alone       | 3             | 3             |                         | 2       |                 | 35    |
| Multiple peptic ulcers   | 4             | 3             | 12                      |         | 3               |       |

\* 6 per cent of gall bladder cases had associated appendiceal lesions

#### ASSOCIATION OF INFLAMMATION OF THE GALL BLADDER WITH DISEASE OF OTHER ORGANS

Inflammatory lesions of the abdomen associated with gall bladder disease have been noted frequently. The appendix, stomach, duodenum, liver, and pancreas are most commonly concerned. The association of these organs in inflammatory disease is not surprising for anatomists have long taught the intimacy of the lymphatic bed in the upper abdomen.

**Appendix.** It is not known whether the direct connection between the appendix and the gall bladder is by the blood stream or the lymph channels, but it is evident that the appendix is infected in most cases of gall bladder disease.

Deaver (13) estimated that in 90 per cent of his gall bladder cases there were associated appendiceal lesions. Blalock found definite evidence of inflammatory changes in the appendix in 129 of 888 gall bladder cases, 14.5 per cent. Moore (48) has estimated that there were appendiceal lesions in from 30 to 40 per cent of his gall bladder cases. McCarthy and McGrath (35) reported that in 52 per cent of 57 cases of cholecystitis and in 44.6 per cent of 118 cases of gall stones the appendix was partially or wholly obliterated, whereas in 2,549 consecutive necropsy cases only 17 per cent showed partial or complete obliteration.

In the 588 cases in my series in which the appendix was examined it was grossly diseased in 351 instances, 60 per cent; there were either dense adhesions or partial or complete

obliteration of the lumen. In the 377 cases of grossly diseased gall bladder in which the appendix was described in 359 the appendix was diseased in 245, 68 per cent. There were therefore 206 appendiceal lesions with no accompanying gall bladder disease, 45 per cent, but with 68 per cent of the diseased gall bladders there were accompanying appendiceal lesions.

**Gastric and duodenal ulcers.** Gastric or duodenal ulcers were found in 142 cases, 24 per cent of the total postmortem series, but they were associated in 105 of 359 cases, 29 per cent, with disease of the gall bladder. In 20 cases more than one ulcer was found.

Eusterman (16) reported that in 13 per cent of 1,000 cases of peptic ulcer gall bladder disease was associated. A summary of the appendiceal lesions and peptic ulcers in this series with associated disease of the gall bladder appears in Table XVII.

The significant feature of the data lies in the proportion of cases of appendiceal disease and peptic ulcer in which there is no associated gross gall bladder disease. In this series 12 per cent of the gastric and duodenal ulcers were not accompanied by demonstrable lesions in the gall bladder or appendix, whereas 27 per cent of the appendiceal lesions were unaccompanied by gall bladder disease or peptic ulcer, and 20 per cent of the gall bladder cases showed no associated appendiceal disease or peptic ulcer (Tables XVIII, XIX, XX, and XXI).

TABLE XVIII — INCIDENCE AND TYPE OF APPENDICEAL AND ASSOCIATED LESIONS OF THE GALL BLADDER

| Appendix                               | Gall bladder  |               |                    |         |         |       |
|--|---------------|---------------|--------------------|---------|---------|-------|
|  | Gross lesions | Cholecystitis | Pancreatic disease | Stomach | Crohn's | Total |
| Surgically removed                     | 8             |               | 5                  | 3       |         | 11    |
| Examined at necropsy                   |               |               |                    |         |         |       |
| Adherent                               | 8             | 4             | 7                  | 4       |         | 44    |
| Obliterated                            |               |               | 1                  | 7       |         |       |
| Both adherent and obliterated          | 5             | 3             | 9                  | 7       | 4       | 44    |
| Peptic ulcers associated               | 4             |               | 1                  | 8       |         | 20    |
| Total                                  | 37            | 08            | 33                 | 60      | 8       | 145   |
| Not recorded                           | 3             | 5             |                    | 4       | 1       | 14    |
| From the clinical file of gall bladder | 56            | 71            | 47                 | 61      | 8       | 61    |

TABLE XIX — APPENDICEAL DISEASE IN ASSOCIATION WITH DISEASE OF THE GALL BLADDER OR PEPTIC ULCER\*

|                            | With lesion of the gall bladder | With ulcer | With both | With both |
|----------------------------|---------------------------------|------------|-----------|-----------|
| Adherent appendix          | 4                               | 2          | 5         | 5         |
| Overlaid appendix          | 34                              | 3          | 12        | 7         |
| Both adherent and overlaid | 34                              | 5          | 1         | 14        |
| Surprisingly removed       | 53                              | 6          | 9         | 5         |
| Total                      | 165                             | 33         | 95        | 6         |
| Percent                    | 46.3                            | 9.37       | 6.9       | 17.37     |

\* 13 per cent of peptic ulcer cases had associated gall bladder disease.

Li er It has long been known that inflammatory changes occur in the liver in a high percentage of cases when there is disease of the gall bladder.

Riedel in 1883 first described the tongue-like projection of the liver in cases of hepatitis and Naunyn in 1892 noted the general enlargement of the liver in gall bladder disease. Langenbach, Fink and Mayo Robson soon corroborated their observations. Grube and Graß have described hepatitis almost invariably with gall bladder disease.

TABLE XX — PEPTIC ULCER IN ASSOCIATION WITH LESIONS OF THE GALL BLADDER OR APPENDIX\*

|                   | With lesions of the gall bladder | With appendiceal lesions | With both | With both |
|-------------------|----------------------------------|--------------------------|-----------|-----------|
| Castrum Duodenale | 16                               | 11                       | 8         | 9         |
| Total             | 44                               | 33                       | 9         | 6         |
| Percent           | 7.8                              | 8                        | 1         | 39        |

\* 83 per cent of ulcer cases there was associated disease of the gall bladder or appendix.

TABLE XXI — INCIDENCE OF PEPTIC ULCER AND LESIONS OF THE APPENDIX WITH DISEASE OF THE GALL BLADDER

|  | Cases | Percent |
|--|-------|---------|
| Associated lesions of the appendix                   | 63    | 46.3    |
| Associated peptic ulcers                             | 44    | 68      |
| Associated lesions of the appendix and gastric ulcer | 70    | —       |
| Total associated lesions                             | 50    | 79.64   |

Peterman, Priest and Graham state that in 1917 in 87 per cent of their 30 operative gall bladder cases there was enlargement of the

liver. Kehr (27, 28, 29) found hepatic enlargement in only 15 to 20 per cent of his cases of cholecystitis. MacCarty (32) found hepatitis in 81 per cent of the cases of cholecystitis and Weible in 60 per cent of 46 cases of cholecystitis. Most of the observers have taken sections of the liver adjacent to the operative site, namely the edge of the liver close to the site of the gall bladder. Tietze and Winkler however in 50 cases of cholelithiasis found evidence of inflammatory changes in the liver in almost every case even in sections taken from the dome of the right lobe of the liver opposite the gall bladder.

In my studies sections were taken from at least three localities in the liver adjacent to the gall bladder from the dome of the right lobe of the liver and from the dome of the left lobe of the liver. It is evident at once that there is a marked variation in the microscopic picture dependent on the site of excision of the specimen. As a rule in this series the liver almost always showed varying degrees of hepatitis in the sections from tissue adjacent to the gall bladder whereas many of the sections from the dome of the left lobe of the liver even in cases of severe cholecystitis with cholelithiasis showed no comparable evidence of inflammatory change.

Among 548 postmortem cases with full records and a careful gross description of the liver microscopic sections were made in all but 62 cases. The microscopic findings are given in Table XXII.

It will be seen from Table XXII that the liver was involved in inflammatory lesions in

TABLE XXII — INCIDENCE OF HEPATIC DISEASE ASSOCIATED WITH DISEASE OF THE GALL BLADDER

|  | Lymphocyte |        | Polymorph |        | Cells   |
|--|------------|--------|-----------|--------|---------|
|  | Total      | Portal | Percent   | Ductal | Percent |
| With lesions of the gall bladder                             | 4          | 4      | 28        | 64     | 45.7    |
| With gross lesions of the gall bladder (including carcinoma) | 5          | 9      | 7.6       | 3      | 45.00   |
| With histereous of the gall bladder                          | 9          | 7      | 9         | 5      | 39.5    |
| With papillary tumor of the gall bladder                     | 33         | 11     | 10        | 6      | 47      |
| With carcinoma of the gall bladder                           | 109        | 35     | 3.7       | 7      | 65      |

a greater percentage of cases with gall bladder disease than without. Also it is evident that the "cholesterosis" group shows a considerably less degree of associated liver lesions than the more evidently inflammatory group of stones or gross lesions of the gall bladder for instance. The latter is especially high because it includes the carcinomata.

The percentage involvement of the liver in cases of gall stones is obviously higher than in the other groups. The "minor gross lesion" group varies but little from the "negative" group in the periductal areas. This of course is not surprising for as will be recalled the "minor gross lesion" group includes those lesions that are not inflammatory diverticula (congenital) adenomata single polyps and so forth. It must be borne in mind too that this group has a very low percentage of hepatic involvement for in this table are included only those cases in which both polymorphonuclear cells and lymphocytes are present that is positive evidence of inflammatory changes.

TABLE XXIII — TOTAL INCIDENCE OF INFLAMMATORY CHANGES IN LIVER IN ASSOCIATION WITH DISEASE OF THE GALL BLADDER

|  | Periductal lymphocytes grade 2 to 4 | Per cent | Percent of total cases |
|--|-------------------------------------|----------|------------------------|
| Without lesions of the gall bladder    | 39                                  | 9.4      | 7.4                    |
| With gross lesions of the gall bladder | 8                                   | 5.6      | 6.69                   |
| With cholesterosis                     | 7                                   | 9        | 4.4                    |
| With papillomatosis                    | 36.3                                | 36.3     | 81.5                   |
| With gall stones                       | 58                                  | 31       | 57                     |

If those instances of periductal lymphocytic infiltration graded as 2, 3 or 4 are added the proportion of hepatic involvement would increase markedly. From the pathologist's point of view at least this group should be included and since pathologists have determined the presence of hepatitis by this means it may well be included in the total list of cases with associated hepatic involvement (Table XXIII).

It is evident from Table XXIII that from 60 to 70 per cent of all livers show evidence of pathological changes at postmortem examina-

tion regardless of the presence or absence of gall bladder disease. The cases of non-inflammatory disease of the gall bladder (minor gross lesions such as adenomata diverticula adhesions to adjacent organs without other evidence of disease of the gall bladder) and "cholesterosis" show a relatively small percentage of associated hepatic disease 60 per cent as compared with the definitely inflammatory diseases such as gall stones 97 per cent.

**Pancreas.** Inflammatory changes in the pancreas are relatively rare in association with gall bladder disease. Foci of lymphocytes and especially leucocytes in the stroma and about the pancreatic ducts were noticeably absent on microscopic examination even in the cases of cholelithiasis.

Fallon states that postmortem examinations of the pancreas show lesions of greater or less degree in 50 per cent of the cases. Bialock found 36 of 735 gall bladder cases in which the pancreas was definitely indurated. The many theories of pancreatitis (those of Deaver, Eggers, Flexner, Archibald and Mann and Giordano) all admit the frequency of gall bladder disease with pancreatitis but the percentage varies greatly. W. J. Mayo has stated that 86 per cent of the cases of pancreatic disease are associated with gall stones and that 7 per cent of the gall stone cases are associated with pancreatitis. Moore (49) estimates that cholecystitis is associated with from 50 to 80 per cent of the cases of pancreatic disease. Barling says that pancreatitis occurs in from 25 to 30 per cent of gall stone cases. Nicoll in 1919 reported that he had operated on 7 patients for gall bladder disease, duodenal or gastric ulcer and in each case found only pancreatitis.

In 1921 Judd stated that pancreatic lesions were relatively rare with gall bladder disease although in a series of 1,290 cases of disease of the gall bladder or ducts he found associated pancreatitis in 26.8 per cent. Pancreatitis as suggested by the hard corn cob feel was found in 14 of 47 gall bladder cases in 21 of which there were gall stones.

Aharez and his coworkers likewise state that pancreatitis is relatively rare with gall bladder disease and my series bears out this





cases of non inflammatory disease ("cholesterosis") Inflammatory changes in the pancreas are relatively infrequent in gall bladder disease

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PROLIFERATIVE GINGIVITIS OF PREGNANCY<sup>1</sup>

By SAMUEL MONASH AB DDS MD NEW YORK CITY  
From the Department of Oral and Maxillary Surgery, School of Dentistry, University of Illinois at Chicago

**D**ISTURBANCES in the mouth during pregnancy have been divided by Kieffer (8) into three classes: neuralgias, gingivostomatitides, and rapidly progressing caries. Rosenstein (13) added a fourth class, namely new growth formation. Poletti (13) increased the list further with hyperactivity of the salivary glands, parosmias of the mucosa, alterations of taste, and exacerbations of diseased processes in soft tissues, periosteum and bone. I shall not in this paper discuss all the above changes but shall limit my discussion to the effect of pregnancy upon the gingival tissues.

The epulis or giant cell tumor is one of the commonest growths found upon the gums. The term is also used loosely to include fibromata of the gums. Numerous writers have observed that the growth of an epulis appears to be accelerated by pregnancy. Thus Gunzert (4) described 5 cases. In one there took place during the first pregnancy a recurrence of a growth which had been excised 3 years before. It was again removed but recurred once more 2½ years later during the sixth month of the second pregnancy. In his second case an epulis began in the sixth month. In third patient had had one for a year. It had remained quiescent until the first month of the sixth pregnancy when it began to grow rapidly. His fifth case showed a rapidly increasing epulis in the early part of the third pregnancy. Four of the five growths on microscopic examination proved to be giant cell sarcomata, the other growth a fibroma.

Perthes (12) reported the following case. The patient 25 years of age had had for 5 years a pea sized growth on the gum of the upper jaw, exactly in the median line. About 3 months after she had become pregnant for the first time she noticed that the growth was increasing in size. When he saw her 2 months later it was as large as a hazelnut. During her sixth month it was removed and its base cauterized. Microscopical examina-

tion showed it to be a giant cell tumor. Two weeks after its removal it recurred and at the birth of her child some 3 months later was so large that speech and closure of her mouth was rendered difficult. Three months after delivery it had shrunk spontaneously to the size of a lentil.

Hesse (5) reported 8 cases of growths in pregnant women. In 5 the growth began in pregnancy. In 2 there was a rapid increase of a growth already present and in 1 a recurrence during pregnancy. Their histological structure is not given by Rosenstein from whom the cases are cited.

Rosenstein (13) reported 2 cases first seen after confinement. The patients stated that the growths had begun during pregnancy and did not regress after delivery. In a third case the growth had begun to form several months before the advent of pregnancy and had increased in size during that condition. All three had been excised but their histological structure was not reported.

No doubt some of the growths described by Hesse and Rosenstein belonged to the giant cell tumor type. At any rate the above cases would tend to indicate that Gunzert (4) was right in stating that pregnancy is not the initiating factor in the production of an epulis but tends to accelerate the growth of one already present or one which has not been fully removed. The cases cited do not justify Rosenstein in ascribing to pregnancy, the power of new growth formation.

It has also been known for a long time that pregnancy is associated with the production of inflammatory changes in the gingival tissues. Biro and Arkovv (1) have described a diffuse gingivitis of pregnancy in which the color of the gum is scarlet red and not grayish white or dark red as in catarrhal gingivitis and the gum edges are especially reddened and swollen.

Kieffer (8) described as follows the gingivitis of pregnancy. The gums are dark red

in color bleeding upon the slightest touch and stand away from the teeth, the changes are most marked in the incisor and cuspid region least in the molar region. The process may extend so far as to cause loosening and loss of the teeth and is generally seen at the beginning of pregnancy.

Musgrave (11) described a gingivitis of pregnancy stating that the gums are swollen and tender and bleed at the slightest touch.

Coles (3) on the other hand stated that he had failed to find any condition of the gums that could be regarded as especially and alone connected with pregnancy. He then proceeded to describe two types of gingivitis in one of which the gums were hyperæmic and in the other anæmic thin and shrivelled in their appearance. He came to the conclusion that if any condition of the gums could be said to be especially associated with pregnancy it was the latter.

It has been observed that in some cases the gingivitis present during pregnancy acquires a proliferative or productive character with spontaneous regression after delivery. Mehliis (9) described one such case. Karner (7) observed in one of his patients reddening and marked swelling of the gingiva with regression to normal after delivery and recurrent proliferation with each subsequent pregnancy. Kiebe (14) reported the case of a woman 36 years of age who had come under observation during her fifth pregnancy. In each pregnancy a growth had begun to form at about the second month. It had been removed several times only to recur. After each delivery it disappeared spontaneously. Hesse (5) observed in 2 patients an increase in the size of hypertrophic gums which had been present before pregnancy.

Zentler (16) reported the case of an anæmic woman 25 years of age who during her first pregnancy showed rapidly progressing caries of the molar teeth and purplish and sensitive gums. During the fourth month of her second pregnancy her gums began to hypertrophy presenting tumefactions here and there. After the birth of her child the tumefactions disappeared and the gums regained their normal appearance. Zentler laid considerable emphasis upon the fact that the woman was

anæmic and attributed the above changes in large part to that fact.

In addition to the cases already mentioned Rosenstein (15) described the case of a woman who had noticed the beginning of a growth between the lower incisors in the fifth month of her pregnancy. It increased in size during that period and was removed immediately after childbirth. He called the growth a papillary fibro epithelioma but his description of its histological structure places it in the class of chronic inflammatory growths as there is thickening and proliferation of the epithelium which in no way resembles carcinomatous tissue and infiltration of the epithelium with leucocytes and of the submucosa with small round cells.

Brophy (2) stated that in pregnant women it was not an uncommon error to operate upon a hypertrophy of the gums which had been mistaken for epulis and that after delivery such hypertrophy usually subsided quickly without treatment. Moorhead and Dewey (10) also mentioned hypertrophy of the gums as being observed in pregnancy occurring toward the middle of the term and lasting until after parturition and even for some time in lactation.

It is thus apparent that the presence of tumor like masses upon the gums of women during pregnancy with spontaneous regression after delivery is not an uncommon occurrence. During the past 3 years I have observed 6 cases which I shall now describe in some detail.

CASE 1 A D. An American negress was first seen in October 1912 at the age of 18 years during the sixth month of her first pregnancy. At the beginning of the second month she had noticed that the gum between the upper right cuspid and first bicuspid was beginning to increase in size. It grew gradually downward over the buccal aspect of the above teeth. Soon thereafter the gum tissue on the lingual side between the same teeth began to proliferate. During the fourth month the gum between the upper left first and second molars extended up the palate for a short distance and also down over the palatal aspects.

The patient was a well developed and well nourished woman whose physical examination was essentially negative except for the mouth condition and the accompanying pregnancy. Looking into her mouth one was immediately impressed by the fact that the above mentioned growths were not isolated



Fig 1 Case 1 Labial aspect of upper gums



Fig 2 Case 1 Palatal aspect of upper gums



Fig 3 Case 1 Labial aspect of lower gums

processes but were part of a generalized gingivitis and proliferation of gum tissue. The gingival margins of nearly all the teeth were hyperemic and swollen. In both directions from the two principal growths smaller growths were seen arising from the interdental spaces. The teeth were in good condition except for deposits of calculus about the necks (Figs 1, 2 and 3).

#### BUCCAL AND LABIAL SURFACES

1. *Upper right.* In the interspaces between the first and second molars and between the cuspid and lateral incisor the gum is slightly inflamed with two red streaks of dilated blood vessels running through it mesially and distally. Between the first molar and the second bicuspid and between the lateral and central incisors the gum is slightly hypertrophied and purplish with no red streak. Between the first and second bicuspid the gum is slightly purplish in color and it is greatly hypertrophied.

The first bicuspid and cuspid are separated from one another by a space of 2 millimeters. In the interspace at the gingiva is a reddish ball of edematous tissue 1 millimeter in diameter. Passing distally there is observed a proliferation of gum tissue in the form of three lobulations each containing a red streak of a dilated blood vessel in the center. Passing mesially from the interspace the gum shows considerable proliferation extending down to the biting surfaces of the cuspid and bicuspid and upward about 3 millimeters beyond the gingival edge. It is about 1.5 centimeters in diameter and has a cauliflower-like appearance. It is composed at its periphery of small lobulations each connected by a stalk with larger lobules which combine to form one mass attached by a pedicle to the gum at the neck of the cuspid tooth. The body of the growth is purplish red in color but directly on the biting surface are observed some yellowish necrotic lobules evidently due to the trauma of mastication. There is a bridge of tissue connecting the above growth with one on the palatal side between the same teeth. It is of similar character but much smaller.

2. *Upper left side.* Between the upper right central incisor and left lateral incisor (left central unerupted) and between the lateral and cuspid the gum is slightly inflamed with two red streaks of dilated blood vessels running through it.

Between the cuspid and first bicuspid the gum is beginning to show proliferation and marked inflammatory changes. Mesially a vertical hyperemic streak is present. At the embrasure gingivally there is a distinct growth 2 millimeters in diameter under which an instrument can be insinuated. There are several hyperemic streaks running through it. By a narrow strand of tissue it is connected through the interspace with a similar growth on the palatal aspect.

Between the first and second bicuspids between the second bicuspid and first molar and between the first and second molars are small growths 2 millimeters in diameter similar to the growth described as being between the cuspid and first bicuspid except that these growths do not extend palatally.

3. *Lower teeth.* Behind the first bicuspid on both right and left sides the gum is normal. Anterior to the above teeth there is gradually increasing hyperemia and lobulation until anterior to the cuspid region on both sides a real but small growth of tissue springs from each interspace.

#### LINGUAL SURFACE

4. *Lower left.* Between the second and first molars and between the upper right cuspid and first bicuspid a large growth is present 1.6 centimeters in diameter similar in all respects to that described under the buccal surface between the upper right first bicuspid and cuspid.

Between the first molar and second bicuspid and between the second bicuspid and first bicuspid the gum is swollen with hyperemic edge.

Between the first bicuspid and cuspid the same condition as that found in the upper left buccal surface between the cuspid and first bicuspid.

Between the cuspid and lateral incisor and the lateral incisor and right central incisor the gum is normal.

5 *Upper right* Between the central and lateral incisors the gum is normal. Between the lateral incisor and cuspid is slight hyperæmia. The gum between the remaining teeth is normal.

6 *Lower teeth* The gum between all the lower teeth shows beginning hyperæmia and lobulation to a slight extent.

The blood Wassermann reaction and urine tests were negative.

In October 1922 in the sixth month of pregnancy the growth in the right cuspid region was excised. At the same time the smaller ones between the three teeth behind the cuspid were also excised to determine if possible the method of growth and any differences between them. At the operation it was observed that the larger growth was attached by a pedicle to the upper portion of the periodontal membrane of the cuspid tooth. The base of the growths was cauterized with silver nitrate. No teeth were removed.

Microscopically no difference could be observed between the tissues removed showing that essentially the same process was at work throughout the mouth. In all there was marked hypertrophy and oedema of the mucosa with here and there considerable downgrowth of the epithelium. The submucosa was oedematous and markedly infiltrated with lymphocytes, leucocytes, plasma cells and fibroblasts. The diagnosis in all was chronic inflammation of gum (Fig 4).

Throughout the remainder of her pregnancy there was no recurrence of the excised growths but considerable enlargement of the palatal growth which had not been touched. In January 1923 she was delivered of a normal child.

Six months later she was again seen. The marked gingivitis and hyperæmia which had been present when she was first observed had practically entirely disappeared. No recurrence of the excised growths had taken place. The only growth still remaining was the large one between the upper left first and second molars on the palatal aspect. It had diminished considerably in size and was now slightly less than 1 centimeter in diameter.

In May 1924 she was again seen. She had had a spontaneous abortion of a few months' old fetus in August 1923. Upon examination of her mouth there was found to be no recurrence in the right cuspid region which was normal. However the palatal growth was considerably larger than when seen 10 months before. It was almost 2.5 centimeters in diameter from before backward and 1.2 centimeters from above downward. It was afterwards ascertained that at the time of this examination she was just at the beginning of her third pregnancy.

In February 1925 she was again observed. She was now in the ninth month of her third pregnancy. Since its onset she had noted a progressive increase in size of the palatal growth. It was now 3.5 centimeters long by 2 centimeter wide extending over the palatal aspects of the first, second and third molars and back over the tuberosity. Throughout



Fig 4 Case 1 Drawing from photomicrograph

the mouth there was present a gingivitis almost identical with that observed during her first pregnancy with here and there smallish proliferations of tissue and a larger one  $\frac{1}{4}$  centimeter in diameter arising from the buccal interdental space between the upper right second bicuspid and first molar. There was no recurrence at the site of removal of the large growth between the upper right cuspid and first bicuspid present during her first pregnancy.

A few days later she gave birth to a normal child. Immediately thereafter the growths began to diminish in size. Six weeks after delivery the dimensions of the palatal growth were 2 centimeters by 1 centimeter as compared with 3.5 centimeters by 2 centimeters just before delivery and its volume was only one third as much (Fig 5).

Ten weeks after delivery the growth was of practically the same size. The patient refused to have it excised therefore the effect of radium was tried. Dr Craver applied to the growth 1800 millicurie units of unfiltered radium emanation. Ten days later it was much flatter with here and there small areas of beginning necrosis. Unfortunately the patient was then lost track of and has not been seen since. However there is no doubt in my mind in view of the well known effects of radium and X-ray upon inflammatory growths that either of them is capable of effecting the disappearance of this type of growth especially if they are used in conjunction with periodontic treatment.

CASE 2 Mrs P white American 27 years old was first observed on April 23 1923. About 2 months before during the fourth month of this her third pregnancy she had noticed that the gum between the lower left lateral incisor and cuspid teeth was



Fig 5 (left) Case 1 Photograph showing growth in third pregnancy  
Fig 6 Case 1 Casts showing size of palatal growth 2 days before and 6 weeks after delivery

beginning to grow up toward the incisor edge. It has since been steadily increasing in size.

She had 2 children both alive and well and had had no miscarriages. The general physical condition was good and the blood Wassermann reaction and urinary findings were negative.

Upon examination her mouth was found to be in a filthy condition. The teeth were extremely dirty and had considerable calcareous deposits about their necks. Most of them were loose especially the lower anteriors.

The growth was situated between the lower left lateral incisor and cuspid teeth which were separated from one another by a space of 1 millimeter. It was 1 centimeter high by 5 millimeters wide at the base by a pedicle to the distal aspect of the periodontal membrane of the lateral incisor from which it extended upward to the level of the incisor edge of the teeth. Mesially it covered almost the entire surface of the lateral incisor and distally the mesio labial angle of the cuspid. It was rather soft in texture did not bleed readily and was reddish purple in color. It could be easily reflected labially showing on its lingual surface the indentation of the labial surface of the lateral incisor and a prolongation backward into the interspace between the lateral and cuspid.

The gum tissue below the growth was red and hypertrophied. Extending backward on both sides into the molar region was an inflammatory rim of gingival tissue about 1 millimeter in diameter. It was of a bright red color and contained numerous dilated blood vessels which ran in a direction perpendicular to the free edge of the gingiva. This gingival rim was freely movable away from the surface of the teeth and showed many slight breaks running in the same direction as the dilated blood vessels. The lingual surface was free of gingivitis except back of the lower incisors and left cuspid where it was present to a slight degree. On the labial surface of the upper incisor, cuspids and bicusps the same type of inflamed gingival rim was present. The molars and the lingual side of all the upper teeth were free. Pus could be expressed from the necks of all the involved teeth.

Röntgenograms showed that all of the teeth had extraordinarily short roots. In many there appeared

to have been resorption of some of the apical portion. This was especially marked in the bicusps and anterior teeth. The lower left lateral incisor showed considerable destruction of its alveolar attachment especially on its distal side where the growth was present.

This patient was permitted to go to term without any operative interference. The growth increased progressively and at the time of delivery was 1.4 centimeters high by 8 millimeters wide. She gave birth to a normal child. Two months later the growth had diminished to the size first observed and was excised.

Microscopic examination. The mucosa was thickened and edematous and sent numerous prolongations downward into the underlying stroma but did not resemble carcinomatous tissue. It was infiltrated with polymorphonuclear leucocytes. The submucosa was considerably thickened and infiltrated with large numbers of small round cells. Here and there were several small masses of calcified material. The diagnosis was chronic inflammation of the gum.

This patient was again seen 6 months later in April 1924 also in October 10, 4 and in May 1925. There was at no time a recurrence of the growth. She had not become pregnant in the interval.

Case 3. E. L. American white aged 27 came under observation in July 1923. At about the beginning of April 1923 during the seventh month of her first pregnancy she had noticed the beginning of a growth on the buccal side of the lower right third molar. It had gradually increased in size until at the beginning of June she stated that it was almost 2 centimeters in diameter. At this time she was delivered of a stillborn child. Soon thereafter the growth began to diminish in size and was 1 centimeter in diameter in July when first seen.

Upon examination her mouth was found to be unclean, large deposits of tartar being present about the necks of all the teeth and green stain on the upper incisors. There was throughout especially on the buccal aspect of the teeth a purplish red rim about 1 millimeter in diameter of inflamed gingival tissue with injected blood vessels.

On the buccal side of the lower right third molar tooth midway between the mesial and distal surface was a reddish purple colored mass about

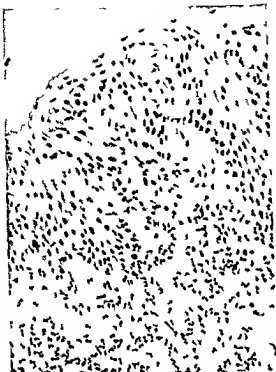


Fig 7 Photomicrograph of specimen from Case 3

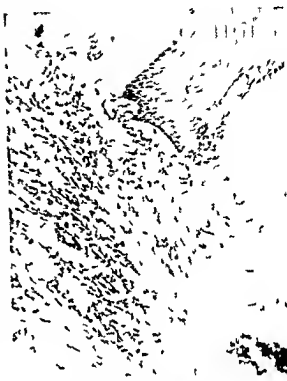


Fig 8 Photomicrograph of specimen from Case 4

flower like in appearance about 1 centimeter in diameter freely movable and attached by a narrow pedicle to the midpoint of the gingival margin of the gum. Between the lower right second and third molars in the interspace buccally there was a small mass of hypertrophied gum tissue about 1 millimeter in diameter. She stated that a growth similar to the one described above had been present in this area and that it had been about 3 millimeters in diameter before delivery. This is interesting in view of the condition found 10 months later.

There was a fixed bridge present consisting of a gold shell crown upon the lower right second molar and one upon the lower right second bicuspid supporting an artificial molar. Both crowns fitted poorly. There were no spaces between any of the teeth.

The blood Wassermann and urinary findings were negative.

The larger growth was excised in July, 1923.

Microscopic examination. The specimen was covered with alveolar mucosa which sent extensive prolongations downward into the underlying stroma. These epithelial masses were made up of apparently normal cells. In the stroma there was marked round cell infiltration. The growth was probably an epithelial and connective tissue hyperplasia due to chronic inflammation (Fig 7).

In May 1924 10 months after the growth had been excised the patient was again seen. She was

again pregnant in her seventh month. There was no recurrence at the site of the previous excision. However between the lower right second and third molars arising from the interspace was a small pedunculated growth 5 millimeters high by 3 millimeters wide. It was dark red in color and freely movable. She had noticed it beginning to form the month before. As will be recalled this area was the seat of a small growth during her first pregnancy.

In October 1924 three months after the birth of a normal child the mass had completely disappeared without any operative interference.

In June 1925 the patient was seen again. The gums were in fair condition. There had been no recurrence. She had not become pregnant in the interval.

CASE 4. S. A. white Armenian aged 22 was first seen in November 1922 during the eighth month of her first pregnancy. Six months before she had noted the beginning of a growth between the lower left central and lateral incisors. It had grown progressively larger during the interim.

There was present in her mouth the same type of injected gingival tissue as in the other cases observed. Deposits of tartar were present about the necks of most of the teeth. Between the lower left central and lateral incisors could be seen the growth a freely movable purplish red mass 1 centimeter high by 1.5 centimeters wide attached by a pedicle



to the gingival gum tissue and extending upward almost to the incisive edge of the above teeth.

The growth was excised by Dr. Fred S. Dunn. Microscopic examination. The mucosa was hyperplastic. Beneath it was a large mass of newly formed blood vessels surrounded by leucocytes plasma cells lymphocytes and some fibroblasts. In another portion was a large area of round cells. The diagnosis was chronic inflammatory tissue (Fig. 8).

Unfortunately this patient was not followed up. CASE 5. B. N. white American aged 5 came under observation in April 1925 during the eighth month of her first pregnancy. At the beginning of the seventh month she had noticed that the gum between the lower right first and second bicuspid was increasing in size and bled rather easily. During the next month it became gradually larger extending upward toward the occlusal edge of the teeth.

Upon examination her teeth and gums were found to be in fair condition. As marked a generalized gingivitis as was seen in the other cases reported was not present. There was some calculus about the necks of the teeth but no marked inflammatory changes except in the region of the growth. Here the gingiva was reddened and passing up from a pedicle was a freely movable reddish purple lobulated mass of tissue 7 millimeters high by 5 millimeters wide.

During the ninth month the growth increased slightly being 8 by 5 millimeters at delivery. Immediately thereafter it began to regress and 2½ weeks later only a reddening and slight thickening of the gingival tissue showed where the growth had been.

CASE 6. S. K. a Polish woman 22 years old was first observed on September 30, 1925 4 days after the birth of a normal child. About 1½ months before she had noticed the beginning of a growth back of the lower anterior teeth. It had increased progressively in size during the remainder of her pregnancy which was her second.

The general physical examination was negative the urine was free of abnormalities. The mouth was in a filthy condition with much calculus about the necks of most of the teeth. There was a marked gingivitis throughout especially on the labial aspect of the lower incisors. Between the lower left central and lateral incisors springing by a narrow pedicle from the distolingual aspect of the central was a reddish purple mass 2 centimeters in diameter similar in character to those already described. The physician who had delivered her stated that the growth was already smaller than when she had come to the hospital 4 days before. Eleven days later without treatment the growth had diminished in size to less than 1 centimeter in diameter and was excised.

Microscopic examination showed the mucosa thickened with considerable new formation of branching bundles of fibrous tissue surrounded by lymphocytes and plasma cells the whole picture being one of chronic inflammation (Fig. 9).

Because of the fact that these growths usually appear during pregnancy, tend to increase in size during that period regress after delivery, are composed of chronic inflammatory tissue and are as a rule part and parcel of a generalized gingivitis I have proposed for the entire condition the name of "proliferative gingivitis of pregnancy." I believe that the term proposed is more descriptive and inclusive than the one occasionally used for the milder types namely hypertrophic gingivitis of pregnancy because it immediately calls attention to the fact that the gingivitis presents the appearance of tumor like masses. It should however be distinctly understood that we are dealing here not with real tumors but only with inflammatory proliferations of gum tissue.

# ETIOLOGY

Brophv (2) has attempted to explain this condition by stating that during the period of gestation the whole organism seems to be endowed with a tendency toward the multiplication of cells and that therefore the gums respond in like manner under irritation. This explanation does not appear to me to be plausible for two reasons first because there is no evidence that I have been able to find that the cells in any part of the body other than those in the organs associated with the growth and nutrition of the fetus and the infant are endowed during pregnancy with a tendency toward multiplication and second because the response of the gums in these cases consists not primarily of a multiplication of cells of the gum tissue but principally of a pouring out of the products characteristic of a chronic inflammatory process namely tissue fluid lymphocytes plasma cells and fibroblasts.

I believe that we must seek the explanation for the changes described along other lines. It has been noted that in practically all the cases I have reported the patients' mouth have been generally quite unclean with considerable deposits of tartar about the necks of the teeth. This would suggest that in all probability even before they had become pregnant their gums had been the seat of a variable degree of gingivitis. Under the

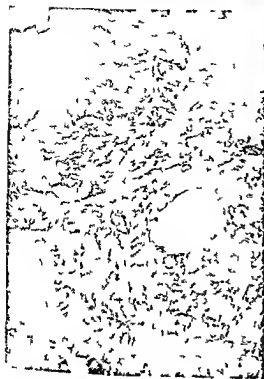


Fig. 9 Photomicrograph of specimen from Case 6

influence of pregnancy the inflammatory response becomes intensified. What had till then called forth a moderate reaction now causes an increased outpouring of the products of inflammation.

One may speculate as to the causes of this apparently increased inflammatory response. Is it due to changes in the chemical composition of the blood stream or is it a vaso-motor phenomenon? Does it perhaps depend upon an increased production of some endocrine product or possibly upon diminished resistance of the tissues during pregnancy? The question is worthy of further study.

The regression after delivery can be explained along similar lines. Microscopically the regression can be seen to be due to a rapid diminution in the oedematous condition of the mucosa and submucosa.

#### IS THERE A GINGIVITIS PECULIAR TO PREGNANCY?

At this point we can consider the question as to whether or not there is a gingivitis es-



Fig. 10 Case 6 Casts showing size of growth 4 days and 15 days after delivery

pecially and alone connected with pregnancy. On this matter I am disposed to agree with Coles (3) who stated that there was not. An examination of a few hundred mouths of pregnant women of all classes of society will show in some the presence of gums of normal health in others of a moderate gingivitis and in still others of an advanced gingivitis with marked proliferation in a few. There is nothing distinctive about the gingivitis found in pregnancy with the possible exception of the marked oedematous condition of the tissues. A long continued irritant upon the gums in many cases will call forth a productive inflammatory reaction almost identical with that observed in the cases I have described and may be seen in women who are not pregnant and in men. Only a short time ago I noticed a tumor like mass about 8 millimeters in diameter springing from the palatal aspect of an upper third molar in a woman of 55 a diabetic who had not been pregnant for 30 years. She had noticed its presence for the past year. Macroscopically and microscopically it was practically identical with the growths I have observed in pregnant women. Hirschfeld (6) has also observed an inflammatory growth similar to the type observed during pregnancy in a man of 34.

If there is then no gingivitis especially and alone connected with pregnancy, why speak of a proliferative gingivitis of pregnancy? For two important reasons: first because the proliferation of gum tissue increases rapidly during pregnancy and ceases with its termination and second because our attention should be directed to the inflammatory nature of such growths so that we may differentiate them from true tumors.

to the gingival gum tissue and extending upward almost to the incisal edge of the above teeth.

The growth was excised by Dr. Fred S. Dunn.

**Microscopic examination.** The mucosa was hyperplastic. Beneath it was a large mass of newly formed blood vessels surrounded by leucocytes, plasma cells, lymphocytes and some fibroblasts. In another portion was a large area of round cells. The diagnosis was chronic inflammatory tissue (Fig. 8).

Unfortunately this patient was not followed up.

**CASE 5.** B. N. white American aged 25 came under observation in April 1915 during the eighth month of her first pregnancy. At the beginning of the seventh month she had noticed that the gum between the lower right first and second bicuspid was increasing in size and bled rather easily. During the next month it became gradually larger extending upward toward the occlusal edge of the teeth.

Upon examination her teeth and gum were found to be in fair condition. As marked a generalized gingivitis was seen in the other cases reported it was not present. There was some calculus about the necks of the teeth but no marked inflammatory changes except in the region of the growth. Here the gingiva was reddened and piling up from a reddish to a freely movable reddish purple lobulated mass of tissue 7 millimeters high by 5 millimeters wide.

During the ninth month the growth increased slightly to 8 by 6 millimeters at delivery. Immediately thereafter it began to regress and 2½ weeks later only a reddening and slight thickening of the gingiva at its base showed where the growth had been.

**CASE 6.** S. I. 1. P. H. woman 2 years old was first observed on September 30 1915 4 days after the birth of a normal child. About 2 months before she had noticed the beginning of a growth back of the lower anterior teeth. It had increased progressively in size during the remainder of her pregnancy which was her second.

The general physical examination was negative. The urine was free of abnormalities. The mouth was in a healthy condition with much calculus about the necks of most of the teeth. There was a marked gingivitis throughout especially on the labial aspect of the lower incisors. Between the lower 1st central and lateral incisors springing by a narrow pedicle from the distobuccal aspect of the central was a reddish purple mass 2 centimeters in diameter similar in character to those already described. The physician who had delivered her stated that the growth was already smaller than when she had come to the hospital 4 days before. Eleven days later without treatment the growth had diminished in size to less than 1.5 centimeters in diameter and was excised.

**Microscopic examination** showed the mucosa thickened with considerable new formation of branching bundles of fibrous tissue surrounded by lymphocytes and plasma cells the whole picture being one of chronic inflammation (Fig. 9).

Because of the fact that these growths usually appear during pregnancy tend to increase in size during that period regress after delivery are composed of chronic inflammatory tissue and are as a rule part and parcel of a generalized gingivitis I have proposed for the entire condition the name of *proliferative gingivitis of pregnancy*. I believe that the term proposed is more descriptive and inclusive than the one occasionally used for the milder types namely *hypertrophic gingivitis of pregnancy* because it immediately calls attention to the fact that the gingivitis presents the appearance of tumor like masses. It should however be distinctly understood that we are dealing here not with real tumors but only with inflammatory proliferations of gum tissue.

#### ETIOLOGY

Brophy (2) has attempted to explain this condition by stating that during the period of gestation the whole organism seems to be endowed with a tendency toward the multiplication of cells and that therefore the gums respond in like manner under irritation. This explanation does not appear to me to be plausible for two reasons first because there is no evidence that I have been able to find that the cell in any part of the body other than those in the organs associated with the growth and nutrition of the fetus and the infant are endowed during pregnancy with a tendency toward multiplication and second because the response of the gums in these cases consists not primarily of a multiplication of cells of the gum tissue but principally of a pouring out of the products characteristic of a chronic inflammatory process namely tissue fluid lymphocytes plasma cells and fibroblasts.

I believe that we must seek the explanation for the changes described along other lines. It has been noted that in practically all the cases I have reported the patients' mouths have been generally quite unclean with considerable deposits of tartar about the necks of the teeth. This would suggest that in all probability even before they had become pregnant their gums had been the seat of a variable degree of gingivitis. Under the

TORULA INFECTION IN MAN REPORT OF A CASE<sup>1</sup>

BY J. L. MCGEEHEE, A. B., M. D., F. A. C. S., AND I. D. MICHELSON, A. B., M. D., MEMPHIS, TENNESSEE  
 From the Department of Pathology and Bacteriology, University of Tennessee College of Medicine

THE following case of inguinal abscess from which a torula was isolated in pure culture is of interest on account of (a) the rarity of torula infection in man, seven authentic cases having appeared in the literature; (b) its unusual occurrence in the colored race; (c) the local type of infection; and (d) the unusual clinical course with recovery.

A brief review of the literature, the clinical and bacteriological findings, including animal experimentation and illustrations, and a comparative discussion of the clinical and bacteriological findings of other authors in relation to those of our case will be presented.

The classification of diseases due to yeast like organisms has proved difficult.

Busse (3) in 1893 reported the first case due to a true yeast. Gilchrist (8) in 1896 described a case due to blastomyces, and Ruxford and Gilchrist (13) in the same year described the organism *coccidioides immitis*. Brewer and Wood (2) in 1908 reported a case of abscess of the vertebral muscles due to a

blastomyces which was cured by operative procedures. In the light of more recent knowledge it was undoubtedly a torula infection and is accepted as such in the subsequent literature. It is the only case not systemic in type but local and ending in recovery. Wolbach (20) in 1915 subdivided the blastomyces into (a) blastomyces yeasts which grow out in mycelium and form endospores; (b) torula yeasts which do not grow out in mycelium nor form endospores. He surmised from the gelatinous character of the lesions due to zooglia formation found in the sections that the two cases of Rusk (14) reported as blastomycosis were actually torulae, although cultures were lacking. Stoddard and Cutler (18) established torula as a clinical and pathological entity. They differentiated it from blastomycosis on a clinical, pathological, cultural, morphological, and experimental basis. Shapiro and Neal (16) reported a case

of torula meningitis of 5 months' duration in a boy 16 years old. Various methods of treatment failed, including the use of serum of rabbits immunized with torula. Freeman and Weidmann (6) reported a case of torula and also reviewed the literature. They brought forth evidence to disprove the accepted theory that cysts of the brain are formed by lysis of tissue due to the specific biological activity of the organism, as stated by Stoddard and Cutler (18). Sheppe (17) reviewed the literature and found that torulae could be recovered from experimental animals although no lesions were evident grossly or microscopically. Hansmann (10) reported a typical case with central nervous system involvement. Bettin's case (1) brought the total to seventeen. Hranova (11) found torula on the tonsil of a young girl and this suggests the tonsil as a possible portal of entry. Sanfelice (15) and others have isolated torula from human malignant tumors, and these strains in the hands of Nichols (12) have proved pathogenic for rabbits and guinea pigs.

In animals Frothingham (7) isolated the torula from a case arising spontaneously in a horse and produced typical lesions in guinea pigs and rats.

In nature torula is widely distributed, occurring in the soil, breweries, on trees, fruits, in and on wasps and bees, in compressed yeast, olive oil, and butter (9).

## REPORT OF CASE

L. M., negro female, aged 26 years, was admitted to Memphis General Hospital December 8, 1924, complaining of pain and swelling of left groin. The family and past history was negative.

The present illness began in August, 1924, with vaginal discharge and pain in the left lower abdomen radiating down the left leg to the knee. Pain was of a dull, aching character, increased by movements. Patient was up and about her home attending to her duties. Sixteen days previous to admission to the hospital a swelling appeared in the left groin which was accompanied by intense pain in the region of the swelling. The swelling increased in size

## TREATMENT

The condition being entirely inflammatory it is essential that preventive treatment be carried out on women before they become pregnant. This should consist in a thorough cleaning and scaling of the teeth, the removal of all badly decayed teeth and poorly fitting dental restorations, the correction of abnormalities of occlusion, a course of massage of the gums and instruction as to the proper methods of using the tooth brush. In other words, all possible sources of irritation to the gums should be eliminated and the tissues brought to a state of normal health.

Should the gingivitis be observed during pregnancy, the above outline of treatment should be instituted immediately. By such means Hirschfeld (6) treated cases and effected a considerable diminution in the size of the growths present while the women were still pregnant.

If the growths do not disappear under such treatment, they need not be removed during pregnancy unless they interfere with the comfort or masticating ability of the patient. After delivery, because of the rapid diminution in size, they can more easily be dealt with and the tendency toward a recurrence is not so great. No teeth need be sacrificed during the process of removal.

## CONCLUSIONS AND SUMMARY

1. Six cases are reported in which tumor-like masses were observed forming on the gums of pregnant women. They began to form at a variable time during pregnancy, increased in size unless treated and spontaneously diminished in size or disappeared completely after delivery.

2. The growth which attracts our attention because of its size is not as a rule an isolated thing in the cases. It is usually accompanied by a generalized gingivitis and represents simply an exaggerated degree of

this condition. The name proliferative gingivitis of pregnancy is proposed for all phases of the condition.

3. This type of growth is inflammatory and should not be classed as a tumor.

4. There is no gingivitis peculiar to and found only in pregnancy. A gingivitis practically identical with that described may be seen at times in men and in women who are not pregnant.

5. Elimination of all irritating factors and if necessary excision of the growth about a month or two after delivery should constitute the treatment.

In closing I wish to thank Dr. W. C. Clarke for assisting in the examination of some of the macroscopic sections. Drs. Douglas Symmer and George H. Senken for many valuable suggestions. Dr. H. S. Dunning in whose clinic several of these patients were first seen. Dr. I. Hirschfeld for permission to use some of his material and Dr. A. Jutkowitz for the preparation of the casts shown.

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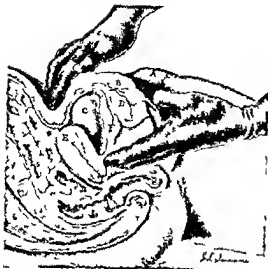


Fig. 1. Sagittal section showing left half of pelvis and upper left thigh. A, Abscess in inguinal region communicating through femoral canal; B, with extraposition at abscess in pelvis; C, D, Symphysis pubis; E, Uterus; F, Bladder.



Fig. 2. Smear of pus from inguinal abscess of human case stained by Michelson's technique. a, Torula phagocytized by large mononuclear leucocyte showing capsul; b, Another large mononuclear; c, Polymorphonuclear leucocytes; d, Red blood cells.

and patient was confined to bed on account of the pain and high fever.

Physical examination revealed a well developed and fairly well nourished negro female living in bed apparently suffering considerable pain. Temperature 101 degrees pulse 135 respiration 24 and blood pressure 11-80. Examination of the head including the eyes ears and nose was negative. The tonsils were hypertrophied, ragged and hyperemic. The thyroid gland was negative. There was a moderate adenopathy of the cervical glands. The lungs and heart were negative. The abdomen was normal in contour and negative throughout except for pain, tenderness and rigidity over the left lower quadrant. Examination of the sexual organs showed a moderate vaginal discharge mucopurulent in character. The uterus was high up pushed over to the right and more or less fixed. To the left of the uterus there was an ill defined fluctuating mass which occupied the left vaginal fornix and displaced the vagina to the right and which appeared to be continuous with the swelling which was apparent in the left inguinal region. A sense of fluctuation was obtained over the inguinal mass by palpation over the mass in the left pelvis (Fig. 1). The skin was warm and moist.

**Laboratory findings.** The urine (catheterized specimen) was of amber color with specific gravity 1.028 reaction, acid. Two or three pus cells to the high power field were found otherwise negative. Blood count showed white cells 25,800 polymorphonuclears 68 per cent lymphocytes 2 per cent eosinophiles none.

basophiles none. Wassermann test showed negative reaction. X-ray of spine and pelvic bones showed them to be normal.

**Provisional diagnosis.** Inguinal abscess originating as a pelvic infection dissecting down the femoral canal.

**Progress notes.** Diurnal variation of the temperature was from 100 degrees a.m. to 101.6 p.m. The pulse ranged from 100 to 120 respiration from 20 to 28.

On December 13 under ethylene anesthesia an incision was made over the fluctuating mass in the inguinal region evacuating a large quantity of pus. Physical examination of the abscess cavity in the groin showed that it communicated with another cavity in the pelvis by way of the femoral canal. The canal was large enough to admit the index finger. Evacuation of the abscess in the groin was followed by immediate disappearance of the pelvic mass. Some of the pus was submitted to the laboratory for examination.

Following incision and drainage the temperature and pulse dropped to a lower course. For a period of 6 days the temperature ranged from 99.4 degrees to 100.4 degrees and the pulse from 92 to 110 after which time a higher course was assumed temperature ranged from 101 to 103 and the pulse from 100 to 120. The temperature was of the remittent type.

The local condition cleared up rapidly and had ceased discharging by the twenty sixth day after the patient entered the hospital. Yet the degree of toxemia was apparently more marked. The temperature range was from 102 to 104 degrees and pulse

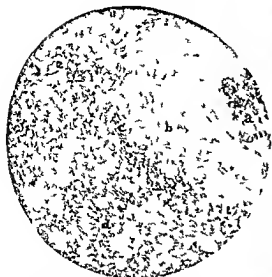


Fig. 5. Lesion of torula in liver of guinea pig the spleen of which is shown in Figure 4. a Center of abscess composed principally of polymorphonuclear leukocytes with some large mononuclears. b Periphery of abscess rich in large mononuclear cells and fibroblasts. c Zone of congestion about abscess. d Hepatic epithelial cells. e Portal space with bile duct, hepatic artery and portal vein  $\times 45$ .

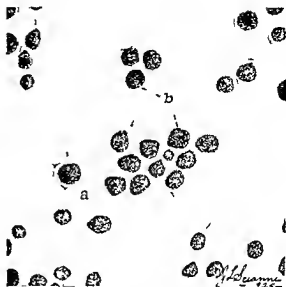


Fig. 6. Smear of pure culture of torula isolated from abscess of liver of guinea pig shown in Figure 5 fixed and stained by Michelson's technique. a Torulae with stained capsular matrix connecting cell. b Torulae lying close together  $\times 3,500$ .

Clinically cases of torula which have so far been recorded in the literature can be divided into (a) The systemic type usually involving the central nervous system simulating brain tumor and tuberculous meningitis. One case of pulmonary involvement has been described simulating tuberculosis, syphilis and abscess of the lung. The white count is usually normal although in a case of Stoddard and Cutler (18) the count ranged from 10,200 to 34,300. The temperature is usually normal but may be elevated as in the above case (Stoddard and Cutler, 18) in which the temperature range was from normal to 103.8. All cases of the systemic type of torula infection have ended fatally. (b) The local type exemplified by a case reported by Brewer and Wood ( ) which was characterized by a localized abscess of the muscles of the vertebral column with slight fever, a white count of 21,000 cells and a rapid recovery. Our case belongs to the latter group.

In our case a vaginal discharge followed by the appearance of a pelvic mass, the high continued remittent and intermittent fever forces one to rule out a gonococcus infection.

Unfortunately no vaginal smears were made. Smears from the pelvic mass were negative for the gonococcus or other pyogenic bacteria. Repeated blood cultures on media suitable for the growth of gonococcus were always negative. Clinically if gonococcal in origin it would belong to the type *Forme Prolongée* of Debre and Paraf (5) with emaciation, arthropathies and usually death. None of these characteristics was present in this case. It is possible that the torula was a secondary invader overgrowing and replacing the gonococcus but it was the only organism seen on smear or on culture. On the other hand yeast-like organisms have been described by Van de Velde (19) in acute inflammations of the cervical mucosa or exacerbation of chronic usually gonorrheal inflammations. In 9 cases inflammation developed suddenly with itching and smarting, grayish yellow discharge, redness and swelling of the vulva and vagina. Colpe (4) saw a long continued endometritis which he claimed was due to a blastomycetes. Thus the original focus of infection in our case may well have been caused by a yeast-like organism. The temperature range of our case is different from that of



On culture the same organism is grown from the pus in pure form as was seen in the direct smear. It shows the same general morphology (Fig. 3) except that the capsular material became manifest only in old cultures and then appeared connecting the cells as well as surrounding them. In broth the growth was poor appearing as a thick adhering sediment with a tendency to grow up the sides of the tube. On Sabaroud's medium the best growth was obtained. Colonies appeared in 24 hours small white opalescent and round which enlarged rapidly becoming coarsely granular and hemispherical then thickly mucoid stringy and pasty with a tendency to heap up in the center. Finally they became confluent. The color changed to a cream tint and then through varying shades of yellow to dark brown. On Sabaroud's slants brownish pigmentation was most marked on the surface and could be scraped off exposing a yellowish layer. On blood agar the growth was sparse and discrete occurring as small grayish white round colonies. On Loeffler's blood serum the growth resembled that on blood agar except that the colonies were smaller and more watery. On the following sugars in Smith fermentation tubes no fermentation was noted at the end of 7 days: dextrose, maltose, mannite, lactose, saccharose, levulose, nutrose, dextrin, salicin, inulin and raffinose. Since it has been demonstrated (9) that the fermentation of yeasts is subject to change and that they can be adapted in their ability to ferment sugars the organism was cultivated on various sugars for 3 months with negative results. There was no liquefaction of gelatin. There was no reaction in litmus milk. Indol production was negative. The organism reproduced by budding only. During the 22 months of cultivation no mycelia have been noted. In old cultures fat globules one to three in number have been seen in the cell and resting cells have been observed. Grown on gypsum blocks at room and incubator temperature no endospores have been seen. The hydrogen ion range was from 4.0 to 8.0. Repeated blood cultures of the human case proved negative for torula and other pyogenic organisms. A special effort was made to demonstrate the gonococcus. Sputum was negative for tubercle bacilli. Smears and cultures of tonsil were negative for torula.

The following animal inoculations were done: A 24 hour broth culture of the organism isolated from the inguinal abscess was well broken up and injected into two guinea pig and two rabbits which at the end of 7 weeks were killed. Guinea pig No. 1 which had received 1 cubic centimeter intraperitoneally showed enlargement of the mesenteric lymph nodes. On section they were gray and soft. Guinea pig No. 2 which received 1 cubic centimeter intracardially showed small circumscribed lesions in the spleen (Fig. 4) liver and kidneys varying in size from pin point to 4 millimeters in diameter and in color from white to a dirty yellow. The small ones were firm the larger ones were raised above the surface softer in consistency and surrounded by red

dish zones. The mesenteric lymph nodes were greatly enlarged on section they were firm and dull in appearance. Rabbits Nos. 1 and 2 injected intraperitoneally and intravenously with 1 cubic centimeter respectively showed the same type of lesions except that the lesions were much smaller from pin point to pin head in size. The brain were negative macroscopically.

Microscopically the smaller lesions proved to be either early abscesses with the normal tissue replaced by aggregates of polymorphonuclears surrounded by a zone of congestion or proliferative nodules composed of epithelial and lymphoid cells. The larger ones (Fig. 5) were older abscesses with centers composed principally of polymorphonuclears with some large mononuclears and a periphery rich in fibroblasts and large mononuclears surrounded by a zone of congestion. The brain and mesenteric lymph nodes showed also the smaller lesions.

The same organism with which the animals were inoculated was cultured from the lesions in the liver (Fig. 6) and spleen of pig No. 2 and kidneys of pig No. 1 and rabbits Nos. 1 and 2.

**Summary of case.** Patient first came under observation with a vaginal discharge and pain in the lower abdomen radiating down the left leg to the knee of 4 months duration. A mass appeared in the left groin 16 days before admission attended with pain and fever for the first time necessitating the patient's taking to bed. The mass was evacuated and found to contain thick cream-colored pus. The patient's discomfort was relieved for a few days only to be followed by high fever lasting 14 days. Subjectively and objectively her condition did not justify so high a fever. The whole picture was suggestive of gonococcal infection but smears and cultures for the gonococcus were negative. The total number of white blood cells was high but the polymorphonuclears were low and there was a mononuclear increase. Torulae were found in the pus either lying free or phagocytized by mononuclears. It was grown in pure culture and proved highly pathogenic for experimental animals. The patient has recovered and is still living. It has been one year since her discharge from the hospital. A recent pelvic examination revealed no adhesions nor the usual evidence of a gonococcal infection. As no other organism was seen or grown we feel justified in attributing to the torula the etiological factor in this case.

The organism isolated from our case was identified as a torula because of the following characteristics: (a) yeast like double contoured bodies which did not form mycelia or endospores. (b) it did not ferment any sugars. According to mycologists torula is a genus including only yeasts which do not produce endospores. Our organism has stood true to the above characteristics over a 12 months period of observation.

SURGERY UPON THE TUBERCULOUS PATIENT<sup>1</sup>

By F. WEBB GRIFFITH, M.D., ASHVILLE, N. C.

THIS brief paper does not deal with the surgical treatment of pulmonary tuberculosis but rather with the results of everyday surgical operations upon patients who are so unfortunate as to have pulmonary tuberculosis.

In a well regulated hospital the course and result of many infections can be charted so that with a large series of cases one could tell fairly well what complications and what mortality might be reasonably expected. If surgical procedures were instituted for instance during typhoid fever the results could soon be accurately tabulated and the value of a given procedure determined. Pulmonary tuberculosis however does not run a regular course. Many cases with very slight tuberculosis and apparently in good physical condition rapidly go to a fatal termination.

On the other hand it is not uncommon for an emaciated desperately ill tuberculous patient to begin almost suddenly and without reason to improve and to go on to cure and remain in good health until death from some other cause. For that reason we can establish no standard for control and merely because a patient with pulmonary tuberculosis improves or becomes worse following a surgical operation is no positive proof that the operation is entirely responsible. However 15 years work among such patients does give me certain fixed ideas which while not proved scientifically I firmly believe. These ideas I present today for what they are worth.

## ANÆSTHETICS

The tuberculous patient is below par and obviously the same care in every respect should be exercised in choosing the anæsthetic as in choosing an anæsthetic for any other substandard man. With chloroform and spinal anæsthesia I have had absolutely no experience. Local anæsthesia with a preliminary hypodermic injection of morphine is by far the method of choice when it can be used. I once heard a prominent surgeon state

that he seldom used local anæsthetics for while he recognized their value he could not get through his day's work of several operations if he had to give the extra time necessary to operate under local. Such an attitude would be entirely out of place in the treatment of tuberculous patients just as it would in many other substandard risks.

For many years I tried to use nitrous-oxide oxygen out of deference to the wishes of some of our local chest specialists who insisted upon that particular anæsthetic. With this it was difficult for me to get complete prolonged relaxation as I have seen in some clinics. As a result the patient was frequently straining at times when complete relaxation was most desired. If as we are told there is increased blood pressure under nitrous-oxide oxygen anæsthesia, that alone would increase the danger in tuberculous patients especially those with a tendency to pulmonary hemorrhage. I have almost completely given up this anæsthetic except when it is practically demanded by the chest specialists and then I use it only under protest.

Ether has been by far the most satisfactory anæsthetic and I am convinced that if carefully given it does practically no harm to the lungs.

If the respiratory tracts of a large number of non tuberculous patients were watched by the chest specialist as carefully for 2 or 3 days after operation as are these tuberculous cases I firmly believe he would find just as large proportion showing bronchial irritation a few rales or possibly a small patch of bronchopneumonia.

For the past 2 years I have been using ethylene to some extent. As yet my experience with it is too limited to form a conclusion but it bids fair to rival if not to replace ether in these cases.

I have tried to analyze the results of one hundred consecutive operations upon patients under treatment for pulmonary tuberculosis. The indications were as follows:

Brewer and Wood (2) both as to height and duration. The patient neither subjectively nor objectively appeared to be as sick as the temperature indicated.

The organism isolated from our case was similar to those described by others in its biological characteristics. Morphologically it differed in the difficulty with which it wills took the ordinary stains. Experimentally although 9 months old the organisms produced lesions in rabbits and guinea pigs more regularly and extensively than those of Sheppe (17) and those of Stoddard and Cutler (18) but less than those of Frothingham (7). Since Stoddard and Cutler used Frothingham's torula it would appear that the organism loses its virulence on subculture. Therefore our torula would have given even more extensive lesions probably if injected earlier.

#### CONCLUSIONS

1. Torula infection in man can be subdivided into (a) the systemic type usually without fever or leucocytosis and always ending fatally, (b) the local type attended with fever, leucocytosis and recovery.

2. The case here presented belongs to the second group, the second of this type to be recorded.

3. This is the first reported instance in which a torula has been isolated from a negro.

4. Pathogenicity of torula varies in different strains and in the same strain on subculture. This may account for the difference in the clinical picture in man and the experimental picture in animals.

We are indebted for assistance in the study of this case to Dr. Harry C. Schnitzer and for the illustrations to

Mr. Joseph L. Schmitt, director and illustrator respectively of the Pathological Institute, University of Tennessee College of Medicine.

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checked the menorrhagia and thereby lessened the drain upon the patients

Removal of the uterus and adnexa and closure of the fecal fistula in a case of chronic pelvic inflammatory disease lifted such a load from the patient that the pulmonary lesion immediately improved. The cough expectoration, and the physical signs of activity in the lungs which had been present for 2 years completely disappeared in a few months after operation.

There comes occasionally to every physician and frequently to those of us who are gynecologists the necessity for deciding whether or not the life of the fetus should be sacrificed in the interest of the mother. In every one of the twenty cases of this series there were two consultants who shared the responsibility with me, one of whom was the lung specialist who had been treating the patient.

In a health resort like Asheville it is not surprising that pulmonary tuberculosis should not only head the list of causes for therapeutic abortion but should exceed all other causes combined. Just what is sufficient indication to justify emptying the uterus in a tuberculous patient is still a much mooted question. You will see one patient who has apparently only a slight lesion and that well arrested pass through pregnancy nicely and then after labor rapidly go to pieces either by a flaring up of the pulmonary lesion or by a general miliary tuberculosis. On the other hand one with an advanced lesion can occasionally go through without apparently doing much damage.

The patients with pulmonary tuberculosis who become pregnant may be roughly divided into three groups: (1) those in whom the disease is so markedly advanced that regard less of pregnancy the duration of life would be at the most only 2 or 3 years; (2) those in whom the disease is moderately advanced and in whom the lesion may be quiescent but who will always be tuberculous; and (3) those with incipient tuberculosis.

Paradoxical as it may seem I believe that termination of pregnancy is most frequently indicated in the first and third groups.

In the first group those who are so far as

we can tell, rapidly losing ground from the tuberculosis alone it is wrong to allow them still further to hasten their end by the burden of a pregnancy when they may not even go to term.

In the incipient cases we have the other extreme. It is reasonably certain that such a patient could go through pregnancy and give birth to a healthy child. But it is almost just as certain that in the meantime she will have herself passed from the incipient to the moderately advanced group. In other words by allowing the pregnancy to continue to full term she has thrown away her golden opportunity to get well. Isn't it much better in such cases to terminate pregnancy at the earliest moment before the tremendous strain is placed upon the lungs and allow the woman to have her chance to become thoroughly recovered from her tuberculosis? Then in a few years she may with a minimum amount of risk have not only one but several children and still maintain her health.

It is in the second or moderately advanced group that there is the greatest difficulty to decide.

In this group if the patient has already one or two children I still believe that her health comes first and that she is not justified in running the risk for the sake of further children. If however she is childless and is willing to accept the risk after it has been thoroughly explained to her I believe the pregnancy should be allowed to continue under careful observation.

In a case in which the religious convictions of the patient do not permit of the termination of pregnancy under any circumstances then the physician has no right to insist but merely explain the dangers and to advise accordingly.

In the 20 cases where pregnancy was terminated the duration of pregnancy estimated from the history and examination was as follows:

| First month                           | Case |
|---------------------------------------|------|
| From first to second months inclusive | 2    |
| From two to three months inclusive    | 11   |
|                                       | 7    |

There were no cases after 3 months. The reason is that all the cases were under the

|  |    |
|--|----|
| Acute appendicitis (unruptured)  | C  |
| Ruptured appendix  | 15 |
| Tuberculosis of cæcum appendix or peritoneum   | 19 |
| Subacute or chronic appendicitis   | 15 |
| (4 of which also had dilatation for dysmenorrhœa)  |    |
| Tuberculosis of kidney   | 1  |
| Tuberculosis of testicle   | 3  |
| Hæmorrhoids  | 3  |
| Cauterization of cervix for leucorrhœa   | 2  |
| Ischio-rectal abscess  | 1  |
| Ischio-rectal fistula  | 1  |
| Excision of persistent sinus of the chest  | 1  |
| Tuberculosis of thumb  | 1  |
| Pruritus perineæ   | 1  |
| (Area of skin size half dollar excised)  | 1  |
| Fibroid uterus   | 2  |
| Curetage   | 3  |
| (Hypertrophied endometrium with glandular dilatation)  |    |
| Chronic pelvic inflammatory disease with ischio-rectal fistula from previous operation                                     | 1  |
| Excised patella  | 1  |
| Cholelithiasis   | 1  |
| (First operation drainage of gall bladder and appendectomy. Five months later cholecystectomy and drainage of common duct) |    |
| Inguinal hernia  | 1  |
| Dysmenorrhœa   | 1  |
| (Dilatation of cervix)   |    |
| Parovarian cyst  | 1  |
| Ovarian cyst   | 1  |
| Termination of pregnancy   | 20 |

There were no operative deaths

These cases were watched for a period of 2 months or longer to determine the results of the operations and the effect upon the lungs

In the fifteen cases of acute appendicitis and the five cases of ruptured appendix the postoperative course and duration in hospital were about as usual. Upon discharge they were naturally a little weaker than they would have been had they been strong and robust before operation. While there was no demonstrable effect upon the lungs for a period of 2 months yet the patients failed to gain in the fight against tuberculosis for that period of time. As however these were all operations of necessity there was no other choice.

There were 19 cases of tuberculosis of cæcum appendix or peritoneum in other words abdominal tuberculosis. In no case was anything done except appendectomy and letting out the acute fluid if present. I did

not feel justified in any of these cases in resecting even when the involvement seemed localized in the cæcum. Possibly I should have been more radical. In three cases there was complete symptomatic cure. In the other 16 the results were questionable. Most of them seemed to improve for a few weeks or possibly months but the final results left much to be desired.

In the group of subacute or chronic appendicitis were 15 cases. Some of these were probably not appendicitis. The rest forced feeding and toxin of tuberculosis form a trial which at times plays havoc with digestion and give symptoms closely simulating the indigestion appendix. When these symptoms of indigestion are interfering with the patient's recovery from tuberculosis there is a big temptation to do an appendectomy. So that while in this group there were a minority who had definite pathological symptoms referring to the appendix and were greatly benefited or entirely relieved of the abdominal symptoms the majority were unimproved. Apparently in none of these cases was the lung condition made worse.

The patient with tuberculosis of the kidney apparently unilateral was not improved at all by the operation. If anything she was made worse and died 3 months later of acute miliary tuberculosis.

Removal of tuberculous testicles of ovarian and parovarian cysts of hæmorrhoids cauterization of the cervix with actual cautery for profuse leucorrhœa drainage of an ischio-rectal abscess cure of the ischio-rectal fistula excision of a sinus of the chest excision of the end of a thumb for tuberculosis, excision of the area of skin of the perineum involved in pruritus perineæ all of these operations gave great benefit when the source of constant irritation was removed and the patients thereby enabled to fight better the pulmonary tuberculosis.

In the two cases of uterine fibroids hæmorrhage was the indication and as the patients were rather young hysterectomy was done instead of radiotherapy in order to save the ovaries.

Curetage in the two cases of hypertrophied endometrium with glandular dilatation

# RAT BITE FEVER COMPLETE REPORT OF A CASE<sup>1</sup>

By WALTER E. HENNERICH, M.D., St. Louis, Missouri

RAT bite fever has been defined as an infectious disease caused usually by the bite of a rat, and characterized by paroxysms of fever by an inflammatory reaction at the site of the wound by enlargement and tenderness of the adjacent lymph glands and by a local or a general exanthema. The exciting factor is thought to be the spirochæta *morsus muris* although a streptothrix has also been described.

Since rat bite fever was first described by Wilcox in 1840 cases have been reported by various Japanese, French, English, and American authors. The Japanese have done extensive experimental work in connection with the disease and have contributed the greatest number of articles in the past few years. Some 140 odd cases have been reported since the above date but only a few cases are in the United States and as far as I can find in the literature only one case in the city of St. Louis which was presented by Dr. John Zahorsky before the St. Louis Medical Society on April 14, 1925.

That the disease is rare is readily established by the fact that we frequently find reports of cases of rat bite yet seldom do we find a report of a case of rat bite fever. It

would seem that only infected rats transmit the disease and also that the disease is more or less rare in the rat itself.

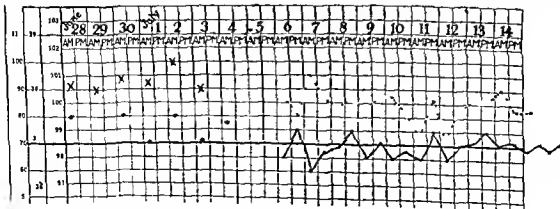
I wish to report a case which fits in well with the excellent discussion of Dembo et al in the *American Journal of Diseases of Children* February 1925.

C. A. H., white male, age 27, was bitten on the right hand by a rat on June 14, 1925. The wound bled a little and then healed but on June 24 (10 days after he was bitten) the patient states that the hand again began to swell and become painful. After losing several nights of sleep he came to me seeking relief, complaining of a swollen hand with a throbbing pain, pain in the axilla, headache, fever, pain in the arms and legs, dizziness and fatigue.

The physical examination was negative except for the local condition and enlarged, painful and tender epitrochlear and axillary glands (on the same side) and a morning temperature of 100 with a pulse of 92.

The hand and the lower one third of the forearm were swollen, painful and tender and on the dorsum of the hand between the fourth and the fifth metacarpal was a bluish or a purplish discoloration about 2 centimeters in diameter about which was an area of redness. An incision was made but no pus was found. Bichloride packs were applied and the patient was advised to use continuous normal saline soaks.

The following day the pain was relieved but for several days the other symptoms remained. No pus was found at any time. I advised the patient to



The temperatures from June 28 to July 6 were morning temperatures and consequently it is presumed that the afternoon readings would be somewhat higher.

From the Surgical Service of the St. Louis University School of Medicine and the St. Mary Group of Hospitals.

close observation of specialists in tuberculosis and when pregnancy occurred the question of termination was discussed. Our attitude has been that if termination is to be done, do it early and give the patient the maximum benefit. In no case in which pregnancy had been allowed to progress over 3 months did we feel it wise to interfere at a later date.

In three or four instances I have had to decide whether it was justifiable to terminate pregnancy the second time. The physical condition of the patient is the criterion and not whether a therapeutic abortion has been done before. I would consent to a second operation only upon condition that we go a step further and sterilize the patient. Some of these patients are young and while at the time not in shape to go through a pregnancy, yet it is possible that a few years later they may be so improved as to be perfectly justified in taking the risk. In such cases instead of doing the usual ligation and cutting of the tubes it would be wiser to employ some of the methods which aim at temporary sterilization. The technique described by Carey Culbertson in 1917 appeals to me more than any other I have seen. This procedure leaves the tubes patent and opening into a small cul de sac in front of the uterus and completely cut off from the rest of the abdominal cavity.

Culbertson performed this operation thirty-one times but unfortunately has not yet had occasion to 'unsterilize' any of the patients so that while it is very pretty theoretically it may not work out so nicely in practice. However, it gives the patient hope that some day she may still be in shape to become pregnant and she is not so depressed mentally as is sometimes the case when a woman realizes that she is permanently and irreparably sterile.

#### CONCLUSIONS

1. Local anesthesia should be used whenever possible. Ether does practically no more harm to the tuberculous than to the non-tuberculous lung and a general anesthesia with ether should be employed whenever the necessity arises. Ethylene bids fair to replace ether in these cases.

2. Pulmonary tuberculosis is not a strong contra-indication to surgery. On the contrary many patients are greatly benefited by the surgical removal of conditions which are indirectly retarding their recovery.

3. Whenever a tuberculous patient becomes pregnant intervention should be considered. If it is deemed wise to allow the pregnancy to go to full term well and good if however it is reasonably certain that intervention will have to be done it should be done early before irreparable damage has been done to the lungs.

CÆSAREAN SECTION AT THE COOK COUNTY HOSPITAL  
FOR THE PAST ELEVEN YEARS<sup>1</sup>By HENRY F. LEWIS, M.D., CHICAGO  
From the Obstetrical Section, Cook County Hospital

In the period from November 5, 1914, to August 27, 1925, there were 170 cesarean sections performed in the Cook County Hospital, Chicago.

The histories of 12 of these known by the records in the warden's office to have been performed during this period cannot be found in the record vaults. The operating room statistics show that cesarean section was done in the 12 cases and the mortality records of the hospital show that none of the 12 died. Therefore we can use for our critical studies only 158 cases.

During this period of 11 years there have been fifteen thousand deliveries at or near term in this hospital. There were 16 deaths in the 170 cases, a mortality of 9.4 per cent. We do not believe that we can be justly accused of doing an excessive number of cesarean sections. In fact the incidence of these operations was 1.1 per cent, or 11 per 1,000. The number performed in 1914 was 3; in 1915, 4; in 1916, 8; in 1917, 6; in 1918, 9; in 1919, 5; in 1920, 10; in 1921, 16; in 1922, 19; in 1923, 23; in 1924, 33; in 1925, (8 months), 22; total, 158.

The increase since 1920 can be accounted for by two factors: first, that cesarean section was not so popular more than 5 years ago as now; and second, that the number of obstetrical cases admitted to the hospital has about doubled in the past 5 years.

My colleague, Dr. W. George Lee, has allowed me to use his statistics on the frequency of cesarean sections in Chicago hospitals taken from records for the year 1923. The estimate is based on the number of cesareans per thousand obstetrical patients treated in each hospital.

The Cook County Hospital had 8 per 1,000; of the other hospitals: A hospital had 42 per 1,000; B hospital had 26 per 1,000; C hospital had 19 per 1,000; D hospital had 13 per 1,000; E and F each had 10 per 1,000. A total of 74

other hospitals in Chicago show an average of 19 per 1,000. It will be seen that the average of the County Hospital for the whole 11 years is 3 per 1,000 more than Dr. Lee's average for the single year 1923, namely 11 per 1,000.

A table showing the ages of our 158 patients follows:

| Age     | Cases | Age | Cases     |
|---------|-------|-----|-----------|
| Unknown | 1     | 27  | 1         |
| 15      | 1     | 28  | 6         |
| 16      | 3     | 29  | 3         |
| 17      | 7     | 30  | 8         |
| 18      | 16    | 31  | 4         |
| 19      | 20    | 32  | 4         |
| 20      | 5     | 33  | 3         |
| 21      | 9     | 34  | 2         |
| 22      | 12    | 35  | 6         |
| 23      | 8     | 36  | 4         |
| 24      | 9     | 37  | 3         |
| 25      | 4     | 41  | 1         |
| 26      | 7     | 45  | 1         |
|         |       |     | <hr/> 158 |

To summarize: There were 90 patients between 15 and 24 years of age; 52 between 25 and 34; 15 between 35 and 45; and 1 case in which the age was not recorded.

The periods of gestation were as follows:

|          |     |             |          |
|----------|-----|-------------|----------|
| Term     | C   | 6 months    | C        |
| 8 months | 118 | Beyond term | 1        |
| 7 months | 22  | Unknown     | 10       |
|          | 6   |             | 1        |
|          |     |             | <hr/> 15 |

The parity of our patients was as follows:

| Unknown | Cases |      | Cases |
|---------|-------|------|-------|
| I       | 7     | VI   | 1     |
| II      | 91    | VII  | 2     |
| III     | 36    | VIII | 1     |
| IV      | 7     | IX   | 1     |
| V       | 8     | X    | 1     |
|         | 3     |      | <hr/> |
|         |       |      | 158   |

There were 29 women who had undergone cesarean section one or more times previously.



enter the hospital for a complete study of the case which he did.

During this period the discoloration at the site of the bite had taken on a distinct purple hue and several macules about 3 millimeters in diameter appeared on the dorsum of the hand and the wrist later developing into pustules.

He was admitted to the St. Mary's Infirmary on July 5, 1925, and assigned to the surgical service. The discoloration had now taken on the appearance of an ulcer 2.5 centimeters in diameter with a central area of dry gangrene 1.5 centimeters in diameter which soon sloughed off leaving a typical punched out ulcer with a dirty gray base.

The complaint upon admission to the hospital was the same as previously, i. e., swollen and painful right hand with a pain extending into the upper arm and armpit, headache, dizziness, and vague pains in the muscles and joints throughout the body.

The laboratory findings were as follows: The urine was amber colored, acid, specific gravity 1.024, no albumin, sugar, acetone, or diacetic acid, no casts or pus cells. White blood count 6,200; red count 4,900,000; hemoglobin 75 per cent; clotting time 3 minutes 20 seconds; Wassermann negative; blood pressure 110/65; Dark field no spirochetes found. Differential count: polymorpho-nuclears 78 per cent, large lymphocytes 12 per cent, small lymphocytes 5 per cent, eosinophiles 3 per cent, mast cells 2 per cent. Blood sugar 91 milligrams per 100 cubic centimeters of blood, non-

protein nitrogen 30 milligrams per 100 cubic centimeters of blood, benzenesulphonethalium 35.0-55 per cent.

Hot bichloride packs 1:5000 were applied and salvarsan 0.4 gram given intravenously. Throughout his stay in the hospital he complained of pain in various muscles and joints over the body, all of which subsided under the treatment.

He was discharged on July 25, 1925, as recovered, and 1 week later reported himself as feeling fine.

**NOTE.**—Patient (C. A. H.) returned on March 3, 1926, stating he has been perfectly well. There has been no discomfort of any sort. The hand, as he states, is as good as ever.

The salient points in the diagnosis are:

1. Positive history of a rat bite.
2. Temperature curve typical of the cases reported.
3. Bluish discoloration at the site of the bite with a local macular eruption about the hand and the wrist.
4. Inflammatory reaction about the site.
5. Enlarged and painful lymph nodes.
6. Incubation period of 10 days.
7. Vague muscle and joint pains.
8. Probable increase in the polymorpho-nuclears and decrease in the haemoglobin.

day postoperative The child was of moderate size weighing 7 pounds 1 ounce

CASE 5 L. L. aged 21 had three cæsarean sections in the County Hospital the first being on August 19 1920 the indication for which was an irregularly contracted pelvis In the three operation there were slight differences as to the pelvic measurements therefore I present the average of the three interspinal 3.5 intercrural 25.5 intertrochanteric 30 external conjugate 18 The highest temperature reached was 100 on the first day after operation but the course was afebrile thereafter The type of operation was the low cervical She was advised to return on the occasion of her next pregnancy Her first labor had been without interference but the child was small 6 pounds 14 ounces The second child weighed 14 ounces more It died within 4 hours with emphysema of the lungs chest and abdominal walls

The patient did not return until she was again in labor November 9 1921 The indication was the irregularly contracted pelvis overriding head and no advance for 6 hours The type of operation was an atypical low cervical cæsarean She ran a slight fever ranging from 101.8 degrees on the third day to 99 on the sixth From the latter date to discharge her convalescence was uneventful

For the third labor she entered the hospital after several visits to the prenatal clinic and was under observation for about 29 days before labor began on March 19 1923 The low cervical operation was done for the third time She was then sterilized She had an acute upper respiratory infection beginning on the fourth day postpartum with a temperature running as high as 103.2 down to 99.4 on the twelfth day

The indications for cæsarean section in the 158 cases as recorded were as follows

|  | Cases |
|--|-------|
| Flat pelvis and previous cæsarean section        | 21    |
| Generally contracted pelvis and previous section | 1     |
| Normal pelvis and previous section               | 14    |
| Flat pelvis                                      | 47    |
| Generally contracted pelvis                      | 1     |
| Contracted pelvis with fetal dysfunction         | 2     |
| Contracted pelvis and ovarian cyst               | 1     |
| Normal pelvis with leg extension (due)           | 2     |
| Funnel pelvis                                    | 23    |
| Normal pelvis long labor with uterine progress   | 7     |
| Placenta previa and fibroid                      | 1     |
| Placenta previa                                  | 2     |
| Placenta previa                                  | 1     |
| Eclampsia  | 10    |
| Nephritis with hypertension                      | 1     |
| Pre-eclamptic toxemia                            | 1     |
| Chronic nephritis                                | 1     |
| Excessive difficult labor with stillbirth        | 2     |
| Form rhenoid labor with bad scars of previous    | 1     |
| Breech presentation                              | 1     |
| Malignant  | 3     |
| Vaginal ten                                      | 1     |
| Flat rachis with flat pelvis with fetal heart    | 1     |
| Multiple fibroids                                | 2     |

|   | Cases |
|---|-------|
| Ab olute indication (ectostosis)                | 1     |
| Leucost of pregnancy                            | 2     |
| Epilepsy  | 1     |
| Intestinal obstruction                          | 1     |
| Carcinoma of stomach with hyperemia             | 1     |
| Oligohydramnios                                 | 2     |
| Carcinoma of cervix                             | 1     |
| Septic meningitis (moribund) for sake of infant | 1     |
| No indication noted                             | 1     |

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## POSTOPERATIVE COURSE

As a means of briefly classifying the postoperative courses of our patients I have divided them into four classes depending upon the severity of the postoperative symptoms including temperature extent of infection etc I have adopted a tabulation based mainly upon postoperative temperature In classifying according to this letter system the time of beginning and the duration of the fever were also included in assigning a letter to each case The postoperative temperatures and course were as follows

| DEFER           | Cases |
|-----------------|-------|
| Over 104        | A     |
| From 104 to 102 | B     |
| From 102 to 100 | C     |
| Under 100       | D     |

The classical cæsarean was performed in 1 A cases 21 B cases 40 C cases 14 D cases with a total of 87 cases

The low cervical section was done in 7 A cases 8 B cases 16 C cases 4 D cases with a total of 35 cases

The transverse cervical section was used in 1 A cases 4 B cases 6 C cases 3 D cases total 13 cases

The longitudinal fundal section was used in 1 A case 4 B cases 9 C cases, 2 D cases, total 16 cases

The Porro cæsarean section was used in 1 A case 1 B case 2 C cases 2 D cases total 6 cases

The vaginal cæsarean section was used in only 1 case of A type

The longitudinal fundal operation leads as to safety both in the mortality and in the morbidity tables The transverse cervical comes next in morbidity but not in mortality The low cervical comes after the longitudinal fundal in mortality but below the transverse cervical in morbidity The classical operation

## Previous Cesareans

| Y r  | Ces. | 1c   | C 3c |
|------|------|------|------|
| 1914 | 0    | 1920 | 2    |
| 1915 | 0    | 1922 | 2    |
| 1916 | 2    | 1922 | 2    |
| 1917 | 1    | 1923 | 3    |
| 1918 | 2    | 1923 | 0    |
| 1919 | 0    | 1925 | —    |

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Brief accounts follow of 5 cases in which the woman was subjected to cesarean section a second or third time in Cook County Hospital

**CASE 1.** M W aged 16 had her first cesarean section July 16 1916. She was a primipara with a slightly justo minor pelvis and a presenting head which remained floating for 15½ hours without advance. Shortly before the operation the cord prolapsed but remained pulsating. The child's head was held up by an assistant during the giving of the anæsthetic. The child which survived the operation was not of large size. The pelvic measurements were interspinal 22½ intercrural 25½ intertrochanteric 30½ external conjugate 19 conjugata vera 9½. The operation was of the classical type. The patient had a rather stormy course of septic type but was discharged on the twenty eighth day in good condition. She was instructed to come into the hospital a month or more before term at her next pregnancy. (Until 1923 we had no prenatal clinic at Cook County Hospital.)

She came back September 10 1917 about 6 weeks before estimated term. She had an uneventful time during this waiting period and came into labor October 16 1917. She was given a moderate test of labor because of the border line measurements of the pelvis and then was operated on by the classical method. Her temperature did not rise above 101 degrees and her course was almost afebrile. The child was large and there had been no advance during the test of labor. She left the hospital in good condition with her child on the sixteenth day after operation.

**CASE 2.** S J aged 35 had her first cesarean section in the Cook County Hospital February 27 1918. She was pregnant at term with her fifth child. All former labors had been normal. Two months before entrance she had swelling of the legs added to her general obesity. Three convulsion had occurred 24 hours before admission. She was not in labor. The head was movable above the inlet. The urine showed albumin and hyaline granular and blood casts in abundance. The blood pressure was 170-130. The pelvis was adequate measurements being interspinal 26½ intercrural 30 intertrochanteric 35 external conjugate 21½.

The day of entrance she was operated upon by the classical method. She ran a moderate febrile course for about 8 days the highest temperature being 101.4 degrees F. A stitch abscess developed

in the wound above the navel but healed before her discharge. She left the hospital on the sixteenth day after operation in good condition with her child.

She again entered the hospital 2 years and 13 days after her last delivery March 3 1920 pregnant at term suffering from pre-eclamptic toxæmia. A small ventral hernia had developed in the upper portion of the wound above the navel where a stitch abscess had formed during the convalescence from her last cesarean section. The urine contained pus and there was much dysuria. The condition continued throughout her stay in the hospital. Her convalescence was almost afebrile. She never showed a temperature over 100.2 degrees F and that only for 9 days. The second operation was a classical one with repair of the ventral hernia. There were many dense adhesions in the abdomen. Abdominal pain had been almost constant during the pregnancy. She left the hospital 30 days after operation well except for slight pyuria which still persisted.

**CASE 3.** L G aged 17 primipara had her first cesarean section September 13 1918 under the indication of an irregular flat rachitic pelvis of the following dimensions: interspinal 23 intercrural 24 intertrochanteric 28 external conjugate 17 transverse diameter of outlet 9. She was about 3 weeks before full term. She was kept in the hospital until term when under the influence of mild pains the head although easily movable became slightly engaged in the inlet. The operation was then performed by the classical method. She had a temperature of 100.4 degree F on the first day postpartum but had an easy convalescence after 16 days.

She entered the hospital the second time June 3 1921 because of advice given at her former discharge. Labor began 6 days after admission and the second classical operation was performed. The measurements at this time showed diameters slightly smaller than those given at the former operation. In addition the right oblique external diameter was found to be 19 centimeters and the left 18. On admission she had an infectious swelling of the jaw and a smear suggestive of gonococcus was taken from the vagina. She had no fever before the operation afterward a mild fever for 3 days. The remainder of the convalescence was uneventful.

**CASE 4.** M B aged 18 had her first cesarean in the County Hospital in 1920. The history of this case cannot be found. It is known however that she had been advised to return for her next labor. She entered the second time January 8 1922 at full term. She had a generally contracted pelvis: interspinal 22 intercrural 24 intertrochanteric 28 external conjugate 10½. The operation this time was the low cervical.

This patient's third cesarean section was performed at the hospital by the same method. She was sterilized by imbedding of the tubes during this operation. She had a slight wound infection with a temperature running between 99 and 101.6 degrees for 13 days. She was discharged on the fourteenth

The autopsy showed general peritonitis and gangrenous endometritis. Perhaps craniotomy at once would have been better treatment in spite of the justo minor pelvis.

CASE 4 1919 M N aged 23 primipara entered suffering with impending eclampsia and having a flat rachitic pelvis with the following measurements interspinal 23 intercrystal 23 intertrochanteric 30 external conjugate 16. She had a very extensive ventral hernia with very thin wall consisting mostly of integument the result of a former operation. The history was vague in regard to the period of gestation but the X rays taken by Dr. Blaine showed it to be between eight and nine months. She was kept in the hospital before operation for about 12 days while the probable period of gestation was being determined. The operation was the classical one with the addition of an operation on the ventral hernia and sterilization. A paralytic ileus resulted which caused the abdominal wall to be so distended that the wound ripped open on the third day after operation.

After the operation the patient ran a nearly afebrile course and died apparently from shock due to the rupture of the wound and the consequent emergency operation necessary to repair it. A criticism of this case might well include the delay of 12 days before operating.

CASE 5 In 1922 there were five deaths. The first one was E W aged 22 14 para height 4 feet 10 inches weight 190 pounds very obese entered the hospital about 4 weeks before her expected time. She had a slightly flat pelvis interspinal 24 intercrystal 25 intertrochanteric 40 external conjugate 21 conjugata vera 9. The history is silent on the former labors. After 40 hours labor the head was still floating. One sterile vaginal examination was made. The classical caesarean operation was performed under the handicap of a very thick abdominal wall. The patient had an almost afebrile course until the nineteenth day after operation when she got up during the night wandered to an adjoining room with a tile floor fell and was found a few seconds later by attendants who heard her fall dead on the floor. The autopsy showed a fractured cranium all thromboses in the iliac veins and the vena cava. The baby weighed 8 pounds 2 ounces.

CASE 6 1922 C B aged 35 1 para had a moderately contracted justo-minor pelvis with no engagement after 24 hours. One sterile vaginal examination was made in the hospital. The pelvis measured interspinal 22 intercrystal 26.5 intertrochanteric 30.5 external conjugate 18.5. Caesarean section seemed indicated because of the age of the patient the apparent fair size of the baby no engagement after 24 hours and a breech presentation. The membranes had ruptured 24 hours before the operation which was of the low cervical type. The only choice in treatment was between embryotomy with a high breech and caesarean section.

The temperature was febrile from the second day running from 100 to 105. The abdomen became

greatly distended and the woman died 10 days after the operation. The autopsy confirmed the diagnosis of septic peritonitis from streptococcus hæmolyticus.

CASE 7 192 B F aged 32 11 para entered the hospital in the eighth month suffering from a septic meningitis. The pelvis was of the justo minor type and measured interspinal 21 intercrystal 23 external conjugate 16.75. One sterile vaginal examination was made. The child weighed 5 pounds 14 ounces. The mother continued her high febrile course after the operation until she died on the second day.

This patient entered in coma had severe ecchæmæ a few days before and showed the spinal fluid cloudy and under pressure. The autopsy confirmed the diagnosis of meningitis. The operation was of the classical type.

CASE 8 1922 C H aged 30 11 para pregnant at term gave a history of a former difficult labor lasting 3 days. An operation for appendicitis in 1911 was followed by peritonitis. There were two abdominal scars. During this pregnancy she had frequent severe headaches dizziness black spots before the eyes with vomiting daily for the last 3 months. The urine contained casts and much albumin.

The operation was the classical caesarean complicated by scars adhesions and presenting intestine. The separation of adhesions and freeing of the intestine was very difficult because of the thorough matting together of the abdominal contents. A small rent was made in the intestine during the course of separation but was sutured as soon as possible. Abdominal drainage was employed.

A suppurating peritonitis and a fecal fistula followed but without much fever. The temperature ran between 99 and 101 and for 1 day only. The patient finally died of exhaustion 26 days after the operation.

CASE 9 192 S G aged 27 primipara pregnant at term showed upon examination a very irregular flat pelvis. There was a marked right dorsal scoliosis kyphosis from the sixth dorsal to the first lumbar vertebra and below a compensatory lordosis. The sacrum was flat and short. The right leg was an inch shorter than the left. The fetal head was overriding. The pelvis measured interspinal 26.5 intercrystal 25.5 intertrochanteric 31 external conjugate 15.5 diagonal conjugate 10. The child weighed only 4 pounds 14 ounces.

The patient had a temperature of 99.6 degrees on the second day after the operation and running between 99 and 101 for 8 days. The urine was negative on entrance but showed large amounts of albumin and casts after operation. The autopsy revealed acute mitral endocarditis with infarcts in the spleen, multiple abscesses in the kidneys and liver besides many adhesions between the uterus and the abdominal wall. This case appears to have been an acute streptococcus infection following the operation. One antepartum sterile vaginal examination was made. The operation was of the low cervical type.

has a worse mortality record than any except the Porro and the vaginal but leads the two cervical operations in morbidity average. It must be remembered that the classical operation has been done by all of the operators and has been the operation performed for most of the severest and most neglected cases.

The highest morbidity of all cases as indicated by highest temperatures is A 30, B 40 C 70, D, 18 total 158.

The temperatures by percentages were as follows

| Oper the            | Class | F   | C | Class | F  | C | Percent | Class | Percent |   |    |   |
|---------------------|-------|-----|---|-------|----|---|---------|-------|---------|---|----|---|
| Classical           | A     | 13  | 8 | B     | 24 | 1 | C       | 45    | 8       | D | 16 | 2 |
| Low cervical        | A     | 20  | 8 | B     | 21 | 8 | C       | 45    | 8       | D | 11 | 4 |
| Transverse cervical | A     | 15  | 4 | B     | 15 | 4 | C       | 46    | 1       | D | 23 | 3 |
| Both cervical       | A     | 18  | 7 | B     | 20 | 8 | C       | 45    | 8       | D | 14 | 5 |
| Longitudinal fundal | A     | 6   | 2 | B     | 25 | 3 | C       | 56    | 2       | D | 22 | 5 |
| Porro               | A     | 16  | 6 | B     | 16 | 6 | C       | 33    | 3       | D | 33 | 3 |
| Vaginal             | A     | 100 |   |       |    |   |         |       |         |   |    |   |

Among the 158 cases here reported we have had 16 deaths. This indicates a mortality of 10.1 per cent in the cases amenable to complete study. On the other hand it must be remembered that there are 1 cases which cannot be completely analyzed because of the loss of the histories but which other records show did not die. Therefore a correct mortality record must include these cases in the percentage. We have then 170 cases recorded with 16 deaths. Our true death rate consequently is 9.4 per cent.

Furthermore our patients come from a class which is full of prejudice which is mostly ignorant and largely poverty stricken. They do not come to us early enough. Often they wait days before they consent to enter the hospital. Even if not infected they are often exhausted and their vitality is already sapped by the great ordeal when they come in. Many of them are attended by midwives or by inexperienced neighbors. Very few have been under the care of experts before they are admitted while few have had much prenatal care of any great value. We make efforts to find out whether they have had vaginal examinations before they come in or have otherwise run in danger of infection but their stories are often unreliable. In many instances we cannot employ measures other than caesarean section on account of religious

beliefs precluding destructive operations which from a strictly scientific standpoint should be applied. We are often driven to the caesarean section against our judgment. If we had transcendent skill or divine judgment we should have a better mortality rate.

Since we have had our own prenatal clinic we have noticed some improvement and I think an improvement which is increasing with time albeit rather slowly. The light of hope seems to be getting brighter.

#### FATAL CASES IN DETAIL

**CASE 1** 1914 L. T. aged 38 parturient unknown pregnant 6 months entered the hospital unconscious and not yet in labor. Her pulse was rapid and full her breathing labored and noisy. The heart area was enlarged the pulmonary and aortic second sounds were accentuated. Eclampsia began soon after entrance followed by deep coma. The fetal heart tones were heard. The temperature was 102 deg rees on entrance and rose to 105.8 on the third day. The urine held a large amount of albumen and the microscope showed hyaline casts and a few erythrocytes.

The woman appeared to be in extremis on entrance and a vaginal caesarean was performed in the interest of the mother. Of course the operation in this instance was a *fortiori* hope.

**CASE 2** 1915 J. S. aged 26 para 2 entered at term entered the hospital suffering with very violent eclampsia which had been present for 17 hours although she was not in labor. The convulsions continued in spite of a classical caesarean section until her death 13 hours after entrance. Her first labor had been normal.

The pelvis was normal the blood pressure was only 144-220 on admission she was not in labor the os was not dilated and the fetal head was floating. The urine was not sufficient for examination. The temperature was normal.

Like the former case this one was almost hopeless at the start yet called for some efforts on our part which were unavailing.

**CASE 3** 1918 G. H. aged 18 prim para 2 entered the hospital after some hours of violent labor with tetanic contractions of the uterus and threatened rupture. There was a marked retraction ring. The pelvis was of a moderate justo minor type. The measurements were interspinal 25.1 craniocaudal 25.5 intertrochanteric 10 external conjugate 27. A vaginal smear showed gonococci. After the operation she was transferred to Ward 43 the female venereal ward. The child weighed 7 pounds 8 ounces.

The postoperative course was very stormy with much pain in the abdomen much distention and with various rales in the lungs. The patient died 25 days after the operation which was of the classical type.

red cells. It was evident that the patient could not recover unless the uterus was emptied. The baby was of 6 months gestation and labor had not begun. Vaginal section seemed to offer the best chance. Any thing else would be tantamount to nothing. Other treatment such as bleeding sedatives and morphine had been tried. She was marked for death when first seen on entrance.

The case of 1915 seems to have been equally hopeless. Severe convulsions had persisted for 17 hours although she was not in labor. Perhaps the vaginal section or other form of accouchement force would have been better than the classical operation which was done. She also had treatment like that of the former case and like the former she resisted all treatment. The bladder contained almost no urine. She died 13 hours after entrance.

The third case of 1921 was that of a woman who entered in the eighth month moribund with septic meningitis. The operation was practically an ante mortem autopsy done avowedly in the interest of the child only.

In the third case of 1924 the patient had had obstruction of the bowels for 4 days before coming in. She was in the eighth month of her eighth pregnancy. The direct indication was the intestinal condition for which the cesarean section was necessary before the obstruction could be treated surgically. I think that the most enthusiastic advocate of a low cesarean operation would have preferred the classical in this instance. The patient succumbed to shock before the cause of her condition could be attacked.

If we should be allowed these 4 alphas our percentage of deaths on the basis of 166 cases would be 7 per cent. On the basis of 154 cases our percentage would be 8 per cent.

#### DEATHS BY TYPE OF OPERATION

There were 10 deaths with the classical operation or 11.5 per cent. by the low cervical or 5.7 per cent. 1 by the transverse cervical or 7 per cent. 3 by both cervicals or 6.2 per cent. no deaths with the longitudinal fundal 2 with the Porro or 33.3 per cent. 1 by the vaginal or 100 per cent. as follows:

| Operation           | Cases | Per cent |
|---------------------|-------|----------|
| Classical           | 10    | 11.5     |
| Low cervical        | 2     | 5.7      |
| Transverse cervical | 1     | 7.7      |
| Both cervicals      | 3     | 6.2      |
| Longitudinal fundal | 0     | 0        |
| Porro               | 1     | 33.3     |
| Vaginal             | 1     | 100      |

#### TYPES OF OPERATION

The classical operation of Saenger was the one most frequently used. Eighty seven such operations are included in the 158 cases belonging to this series. Six patients were operated upon by the Porro method. One vaginal cesarean section was done. The low cervical operation of Kroenig was done by two of us. These operations numbered 48. One operator employed the low incision through the abdominal wall with the longitudinal incision through the lower segment and cervix the other made a transverse opening through the cervical muscles usually with the fingers. The former method I have termed the low cervical and the latter the transverse cervical. There have been 35 low cervical and 13 transverse cesarean sections.

Another type of operation has been done by two of us for a few years. This I will call the longitudinal fundal cesarean of which there were 16 cases. The incision long enough to allow dislocation of the uterus is made in the abdominal wall in the median line about half above and half below the navel. After the uterus has been everted the abdominal wound is temporarily held together by means of one or two vulsella and the base of the uterus is lightly packed with gauze. Thus the spill is well controlled and we rarely have any fluids leaking into the belly. The uterine incision is made longitudinally in the median line of the fundus of the uterus large enough to permit delivery of the baby and extending equally fore and aft. By tilting the uterus the spill can be directed away from the wound. One advantage is that the uterine wound is as far as possible away from the usual source of infection which is almost always via the genital canal. It is the ideal method for the case of placenta praevia in which the cesarean operation may sometimes be indicated.

CASE 10 In 1923 there were 3 deaths. The first was F. R. aged 19 primipara pregnant near term who entered the hospital with hemorrhage and other symptoms of placenta previa. A sterile vaginal examination just before operation confirmed the diagnosis of placenta previa marginalis. The pelvis was just of considerable degree with the following measurements: interspinal 20, intercrural 3, external conjugate 16, diagonal conjugate 9 plus true conjugate 8 minus.

The classical operation was performed a short time after entrance. The patient appeared to be in good condition. Fever appeared about the second day after operation and rose to 104. Symptoms of lobar pneumonia appeared within a few days and ran a rapid course. The urine contained a moderate amount of albumin with hyaline and granular casts. Death occurred 19 days after the operation which was not difficult and did not last unduly long. Perhaps the anæsthetic was to blame although the ether was administered by one of our best anæsthetists.

CASE 11 1923 B. D. aged 16 secundipara entered the hospital after a hard labor of 36 hours duration. The pelvis was adequate measuring interspinal 24, intercrural 30, intertrochanteric 39. A sterile vaginal examination just before operation showed that there was a large exostosis at the promontory which much reduced the true conjugate diameter. A history of the first labor was not obtainable and no time was spent in trying as the woman was apparently exhausted. She was operated upon by the classical method very soon after entrance. The urine taken by catheter during the preparation showed much albumin and many pus cells. The patient was in much shock at the end of the operation while sutures were being passed and died while dressings were being applied.

CASE 12 1923 M. McN. aged 19 primipara pregnant at term entered the hospital after a rather long labor under the care of a midwife who had made one or more questionable vaginal examinations. The external measurements were interspinal 22, intercrural 24, intertrochanteric 31.5, external conjugate 21.5. A sterile vaginal examination just before operation showed a prominent exostosis on the right iliac spine which reduced the diameter of the canal to the absolute indication just before operation the membranes ruptured.

The classical operation was done. Of course the placenta and membranes had to be brought through the cervix through which the membranes had prolapsed at the time of rupture. Although this was done with the greatest possible care it is likely that this factor weighed much in the development of a speedy peritonitis with temperature reaching nearly 104 during the 7 days before the fatal end. In this case embryotomy would have been even a greater risk than a cesarean.

CASE 13 In 1924 there were 3 deaths. The first was E. G. aged 41 multipara pregnant 8 months who entered with a history of obstruction of the bowels for 4 days. On account of her pregnancy she

was sent to the obstetrical ward but because of the evident necessity for haste one of the surgeons of the hospital who happened to be present kindly consented to operate. The classical cesarean section was successfully and speedily done but the patient died of shock before the intestine could be begun.

CASE 14 1924 L. W. aged 26 primipara suffered from a pregnancy at term complicated by numerous small fibroids. There had been brisk labor pains without any progress for 30 hours before the operation which was started soon after the patient's admission. The pelvic measurements as recorded were interspinal 23, intercrural 26, intertrochanteric 31, external conjugate 20. The history stated that the pelvis was generally contracted. This must have been correct since the baby's measurements were 10 pounds 15 ounces length 54 centimeters bi-temporal 9, suboccipitobregmatic 12, occipitofrontal 12.5 and occipitomenthal 14.

The Lombr operation was done. The temperature ran from 99 to 103; the pulse became rapid and hunger came on suddenly and the woman died on the third day after operation. The autopsy revealed a large amount of blood from a severe intraperitoneal hemorrhage.

CASE 15 1924 M. R. aged 28 primipara pregnant at term entered with placenta previa complicated by fibroids. The pelvis was adequate with a diagonal conjugate of 12.25. There had been considerable hemorrhage because of the low attachment of the placenta. The baby was dead. A Cesarean was performed. The mother died on the table in spite of saline solutions given subcutaneously and blood transfusion. The X-ray had shown a calcified fibroid obstructing the fetal head.

CASE 16 1925 T. F. aged 19 primipara entered after a prolonged dry labor of 33 hours without progress. She had a moderately flat pelvis measuring interspinal 22, intercrural 24, intertrochanteric 3, external conjugate 20, conjugate diagonal 9.5, bischial 7.5. The child however was not large. Two vaginal examinations had been made previously. The patient developed a high temperature which reached 105 with frequent chills. She died on the seventh day of acute gangrenous endometritis and acute generalized peritonitis. The operation was of the transverse cervical type.

There are 4 of our deaths which perhaps could not fairly be charged to the operation *per se* because of peculiar circumstances concerning the operations.

The death in 1914 in the case of the vaginal section is one of these. The patient entered in deep coma alternating with very severe convulsions. The heart was much damaged, the urine was loaded with albumin casts and

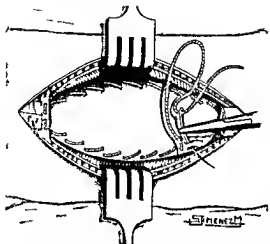


Fig 3 Catgut suture closing the pleural cavity and connecting the ends of the ribs

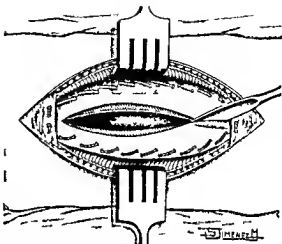


Fig 4 Drawing showing the incision of the pleura and diaphragm

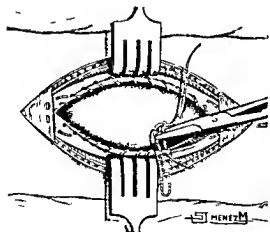


Fig 5 Suture which fixes the liver and diaphragm and closes the abdominal cavity

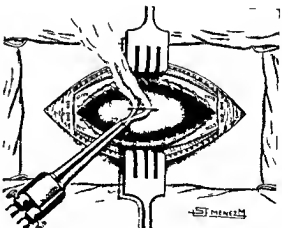


Fig 6 Showing the method of puncture of the abscess with the galvano-cautery

*Surgical Treatment of Abscesses of the Liver—Lisies Valles*



## CLINICAL SURGERY

FROM THE CLINIC OF THE SINATORIO VALDES

## SURGICAL TREATMENT OF ABSCESES OF THE LIVER

By ULISES VAIDES FACS Mexico City Mexico

**L**ARGE liver abscesses usually of amebic origin are treated by drainage into the lowest part as are abscesses in almost any other region. If the drainage is ample and is placed in the correct position cicatrization even in the largest abscesses takes place rapidly in from 3 to 4 weeks but if the drainage tube is placed so that it is too straight or is over the base of the abscess the period of healing is prolonged to one or more months necessitating among other inconveniences a longer stay in the hospital and a greater expense and a longer period of incapacity for work.

Abscesses of the liver which rupture spontaneously into the stomach or intestine generally heal readily because the position of the opening is favorable for cicatrization. On the other hand abscesses which rupture into the bronchi never heal spontaneously because the opening is high

and in such cases it is necessary to drain the abscess at its base.

Drainage of these abscesses is accomplished by either of two methods. (1) by arranging an ample canalization in the lowermost part of the abscess or (2) by not infecting the pleural and peritoneal cavities which are frequently encountered in operations performed at the opportune moment.<sup>1</sup>

## TECHNIQUE

We do not make a puncture for diagnostic purposes alone until we are prepared to proceed with the operation because if the needle enters a pus pocket the entire course of the needle is apt to become infected as the needle is withdrawn. Puncture is done only at the time of operation when the patient has been anesthetized. An

The third method which differed from those mentioned  
 Les patients dyslexiques 6 4 1 7 1 4 5 lesophiles 7 7

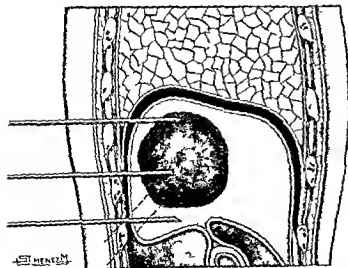


Fig 1 A schematic drawing showing the site of puncture. The interrupted line shows the position of the drainage tube.



Fig. 2 The skin incision measuring 12 to 15 centimeters in length is curved downward.

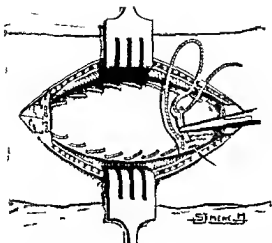


Fig. 3 Catgut suture closing the pleural cavity and securing the end of the ribs

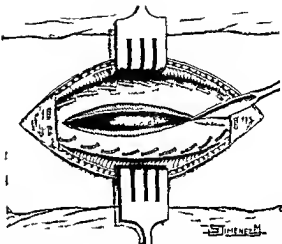


Fig. 4 Drawing showing the incision of the pleura and diaphragm

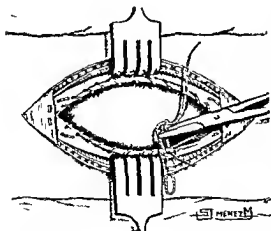


Fig. 5 Suture which fixes the liver and diaphragm and closes the abdominal cavity

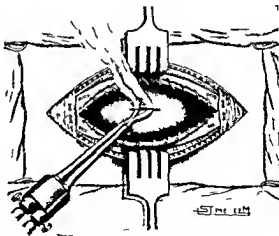


Fig. 6 Showing the method of puncture of the abscess with the galvanocautery

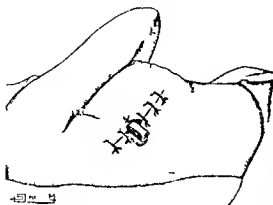


Fig. 1 Appearance of wound at end of operation. Note the oblique direction of the tube.

attempt is made to locate the purulent collection especially the base. To this end a puncture is made over the point of maximal pain presumably over the center of the abscess and with another needle a second puncture is made some centimeters deeper according to the assumed size of the abscess. If a pus pocket is entered and pus is extracted, the process is repeated the needle being changed each time until the syringe when withdrawn contains no pus (Fig. 1). This will be the point of incision and the rib immediately above this point is the rib which is to be resected. If the fundus of the abscess is found to be below the costal margin the operation will be entirely abdominal.

Taking the point of the last puncture as a center a curved incision 12 to 15 centimeters is made so that the two ends extend to the lower edge of the rib above the one being resected and the lowest point of the incision is at the upper edge of the rib immediately below the one being resected (Fig. 1).

The rib is resected subperiosteally the entire length of the incision care being taken to preserve the periosteum so that the cut ends of the rib are

covered and osteomyelitis is thus avoided. Osteomyelitis is a frequent complication when pus is allowed to come in contact with the cut ends of the ribs, fistulae forming which require another operation.

After the rib is resected and before the pleural cavity is opened the edges of the incision are drawn back with two retractors and an oval line of catgut sutures including the pleural walls and the ends of the resected rib is made (Fig. 3).

The incision is made through the pleura and the diaphragm into the peritoneal cavity to expose the surface of the liver (Fig. 4). Then a second row of sutures is made concentric with the first to include the edges of the wound in the diaphragm and the surface of the liver (Fig. 5). The surface of the liver is thus fixed and exposed. In this manner the pleural and peritoneal cavities are protected from drainage of pus. If the liver has become so damaged by the infectious process that the sutures become loosened gauze is packed between the liver and the diaphragm and allowed to remain for 3 or 4 days. In this manner adhesions are produced which again effect a separation of the abscess from the serous cavities.

With gauze moistened in serum all bleeding surfaces are protected leaving exposed only the surface at which the red hot electric cautery is to enter.

As the incision has been placed in a plane far below the abscess a new puncture must be made to locate the abscess the needle being followed by the electrocautery (Fig. 6) or if preferred by the point of a closed arterial forceps so that the pus gains slow exit. By opening the forceps the wound in the liver is enlarged to an inch or an inch and a half and a large tube (a centimeter or  $\frac{3}{4}$  centimeter in diameter) is inserted and fixed at the edges of the wound (Fig. 7).

The wound is closed in layers with the drainage tube fixed in place. The wound is dressed once or twice daily according to the amount of discharge. The day after operation the patient is removed to the open air in a wheel chair. In cases of amœbic abscess daily injections of emetin will favor cicatrization.

## FROM THE DIVISION OF SURGERY, MAYO CLINIC

## CHOLECYSTGASTROSTOMY

BY WALTER WALTERS M.D. ROCHESTER MINNESOTA

**A**nastomosis between the gall bladder and the stomach is made to allow the passage of bile from the gall bladder into the stomach when the former is distended as a result of obstruction in the distal portion of the common bile duct either from stricture or pancreatic obstruction. To insure adequate function the obstruction must be entirely distal to the entrance of the cystic duct into the common duct. In two of every three cases the lower portion (1.5 to 2.5 centimeters) of the common duct passes through the substance of the pancreas and in these cases pancreatitis or carcinoma may cause compression of the pancreatic portion of the common bile duct sufficient to produce painless and increasing obstructive jaundice. Cholecyst gastrostomy short circuits the bile into the intestinal tract thus relieving the biliary obstruction the jaundice subsides and with it the persistent pruritus so annoying in such cases. If the obstruction is due to stricture or pancreatitis the patient's recovery will be permanent. The risk of the operation is from the oozing from jaundiced tissues which can be prevented by intravenous injections of calcium chloride from bleeding into the lumen of the anastomosed structures from the cut ends of enlarged veins in the wall of the gall bladder which can be prevented by a haemostatic inverting stitch of the button hole locking

type and from leakage in the suture line as a result of tension of the stomach when distended with fluid.

The hemorrhagic tendency of jaundiced tissues can be controlled in most instances by intravenous injections of 5 cubic centimeters of a 10 per cent solution of calcium chloride given daily for 3 days prior to operation. If this does not reduce the coagulation time of the blood to within normal limits it may be accomplished by transfusing blood. Operation should be postponed until the coagulation time of the venous blood is less than 6 minutes. The toxæmia is associated with the accumulation of non protein nitrogen in the blood and tissues of the body and a lack of available glycogen in the diseased liver. To compensate for this abundant fluid to induce diuresis is indicated by mouth usually but for patients who have difficulty in taking fluid by mouth intravenous injections of physiological sodium chloride solution and 10 per cent glucose solution are also recommended. The diet should consist of an abundance of carbohydrates. This method of pre operative preparation of patients with obstructive jaundice was begun at the Mayo Clinic 4 years ago and has been used as a routine since then. As a result the incidence of post operative hæmorrhage in cases of obstructive jaundice when biliary obstruction has been

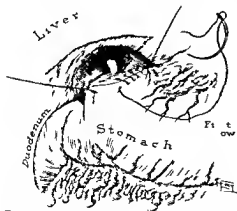


Fig. 1 Interrupting sutures approximating stomach and gall bladder and first row of continuous Lembert suture approximating peritoneal coats of stomach and gall bladder.

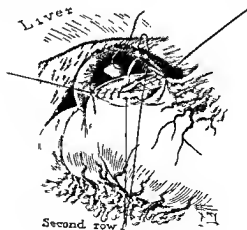


Fig. 2 Incision through peritoneal and muscular coats with union and approximation by continuous suture.

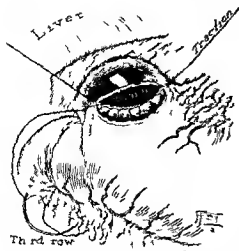


Fig. 3. Lumen of stomach and duodenum and approximation of mucous membrane by a locking suture a continuation of that used in Figure 2

adequately relieved at operation has been reduced to less than 2 per cent.

The anastomosis is made between the gall bladder and the portion of the upper intestinal tract which lies in closest proximity and which can be applied to it with the least amount of tension usually the stomach or duodenum. Should the duodenum be adherent to the gall bladder anastomosis between these two is easily performed. Anastomosis between the gall bladder and the stomach can be easily and safely accomplished because of the better blood supply and the greater thickness of the gastric wall which allows three rows of sutures to be used as in gastro-enterostomy. If the gall bladder is anastomosed to the stomach a convenient point for the attachment is about 7.5 centimeters above the pylorus near the lesser curvature.

The operation is essentially that of any lateral anastomosis in which three rows of sutures are used. A hitch locking from the lumen inverts the cut edges of the gall bladder and stomach approximates their peritoneal surfaces and at the same time prevents bleeding into the lumen of the gall bladder or intestine from the cut ends of the enlarged veins in the wall of the gall bladder (Fig. 4). The operation can be accomplished with or without the use of the Doyen clamps although preferably without because of the possible injury to the walls of the gall bladder from compression by the clamps. Without the clamps a suction pump can be employed to

empty the stomach and gall bladder of their contents and when placed at the dependent angle of the anastomosis assists in keeping the field of operation dry. Before the stomach and gall bladder are opened gauze packs are inserted to prevent leakage during the operation into the left and right subhepatic fossa and the general peritoneal cavity. The contents of the distended gall bladder are removed through a trocar introduced into the gall bladder at a point which when extended can be included in the anastomosis. The gall bladder and stomach or the gall bladder and duodenum are approximated by two interrupted sutures at points just beyond what are to be the extremities of the anastomosis (Fig. 1). In this way the anastomosis can be accomplished as easily as though clamps were approximating the two viscera. After the first row of sutures has been inserted incision is made through the peritoneum and muscle of both stomach and gall bladder which are approximated by a second continuous suture (Fig. 2). The mucous membrane of both viscera is opened and the edges approximated by a continuous suture backward, of the locking type (Fig. 3) joining the submucosa and mucosa. This controls the bleeding from the vessels in the submucosa in the posterior line of the anastomosis. The same suture is continued across the anterior edge of the anastomosis the stitch being locked from the inside surfaces of the gall bladder and stomach. This not only approximates their peritoneal surfaces but more important controls the bleeding from the large veins in the walls of the distended gall bladder (Fig. 4). The first row of suture begun posteriorly is continued forward after the method of Lembert slightly inverting the anterior suture line. A portion of the gastocolic omentum is used as a patch to cover the posterior line of anastomosis while the gastrophatic omentum is similarly applied to cover the anterior line (Fig. 5). Tension on the anastomosed parts is prevented by attaching a portion of the anterior wall of the stomach proximal to the anastomosis to the falciform ligament of the liver by a few interrupted catgut sutures thus keeping it to the right of the pylorus a point emphasized by W. J. Mayo in Billroth I resections. Two Penrose drains extending from the ends of the anastomosed area through the abdominal wall are used as a precautionary measure in case there should be any leakage of bile.

A stomach tube should be passed if there are any signs of gastric retention as evidenced by hiccups a feeling of fullness in the epigastrium



Fig 4. Locking suture uniting anterior walls suture lockin from the inside

or an increase in pulse rate. Gastric retention drags the stomach to the left of the spine and places great tension on the line of anastomosis which must be prevented. Fluid is supplied by proctoclysis and hypodermoclysis. Neither fluid nor nourishment should be given by mouth for 3 days in order to allow complete healing at the point of anastomosis.

#### SUMMARY

Cholecystgastrostomy successfully performed establishes a path of continuity between the intestinal tract and the biliary tract if there is obstruction distal to the point of entrance of the

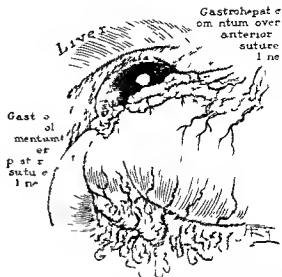


Fig 5. Suture of portion of gastroduodenal and gastrohepatic omentum over anterior suture line

cystic duct. Besides the usual precautions necessary in any abdominal operation the prevention of postoperative hemorrhage and the prevention of tension at the line of anastomosis in these cases are of primary importance. The former is accomplished by controlling the oozing from tissue by preoperative intravenous injections of solutions of calcium chloride and preventing the bleeding into the lumen of the intestine and gall bladder from the large veins in the wall of the distended gall bladder by means of an accurately placed hemostatic suture. Tension on the suture line of the anastomosis is prevented by attaching the portion of stomach proximal to the anastomosis to the falciform ligament of the liver by interrupted catgut sutures keeping the pylorus to the right of the spine.

## FROM THE SURGICAL CLINIC ST JOSEPH'S HOSPITAL

## THE TECHNIQUE OF SUSPENSION OF THE UTERUS

BY IRVIN ABELL, M.D., LOUISVILLE, KENTUCKY

THE preparation of the patient for operation for suspension of the uterus conforms to that usually employed for abdominal operations—cleansing and shaving of the abdomen on the day before operation with the application of a 1 per cent tincture of iodine to the field of operation on the morning of the day of operation and again when the patient is on the operating table.

The patient is placed in the Trendelenburg position. A four inch midline suprapubic incision is used (Fig. 1). Guy sutures of catgut are placed through or under each round ligament midway between their attachment at the cornua of uterus and their exit through the internal abdominal rings and each suture is held by an artery forceps (Fig. 2). The sheath of the rectus is opened on each side in the midline incision and by blunt dissection the rectus abdominis gently separated from the under surface of the abdominal fascia (Fig. 3a).

A blunt pointed curved artery forceps is passed out under the fascia above the rectus muscle

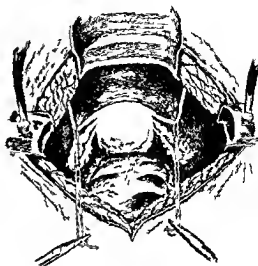


FIG. 2. Guy suture.

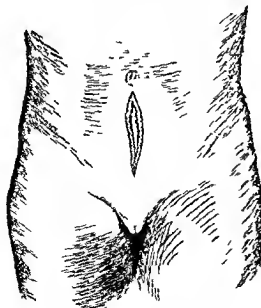


FIG. 1. Suprapubic incision.

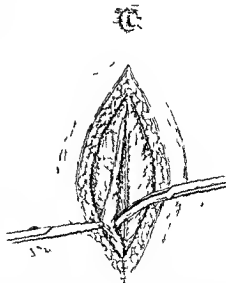


FIG. 3a. Sheath of the rectus opened and rectus abdominis separated from under surface of abdominal fascia.

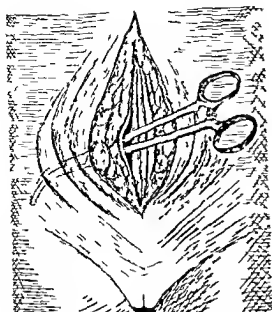


Fig. 3 The blunt pointed curved artery forceps passed out under the rectus abdominis muscle etc

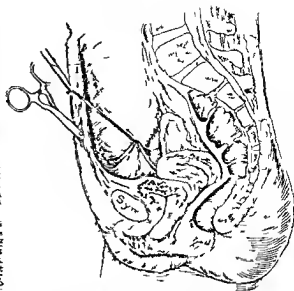


Fig. 3a The inner aspect of the internal ring

The blades of the artery forceps are separated the guy suture in the round ligament grasped and drawn through the internal ring into the midline incision further traction brings the elongated round ligament doubled on itself through the



Fig. 4 The elongated round ligament doubled on itself brought through the internal ring on the upper surface of the rectus

below the posterior termination of the sheath of the rectus to the outer aspect of the internal ring with the abdominal wall of the corresponding side elevated the inner aspect of the internal ring is made prominent by traction on the guy suture in the round ligament and the artery forceps is forced in through the internal ring under the peritoneum and on the upper surface of the round ligament penetrating the peritoneum when well within the limits of the parietal peritoneum



Fig. 4a Showing position of round ligament beneath fascia



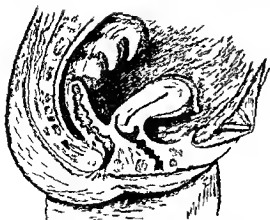


Fig. 5 Double fold of round ligament spread out in shape of triangle

internal ring over the upper surface of the rectus and along the under surface of the fascia to the midline incision (Figs. 3, 3a, 4 and 4a).

The double fold of round ligament is spread out in the shape of a triangle and anchored to the under surface of the fascia with three catgut sutures: the apex at the cut edge of the fascia in the midline incision, the base looking outward toward the outer border of the rectus (Figs. 5, 5a and 5b). The same steps are carried out with

opposite round ligament. The midline incision is closed in tiers: the apex of each round ligament being sewed together as the fascia is closed (Fig. 6). No. 1 chromic catgut is used to suture the round ligament. No. 1 or No. 2 chromic catgut for the peritoneum and fascia; dermal sutures are used for skin or stay sutures of silk or norm gut, if

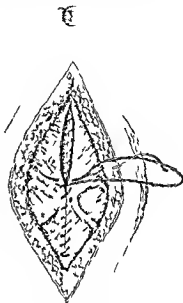


Fig. 6 Manner of closure

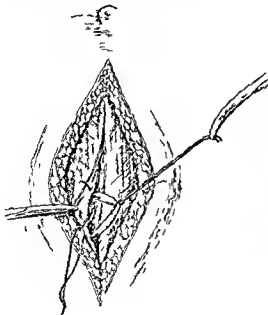


Fig. 5a The fold anchored with three catgut sutures.

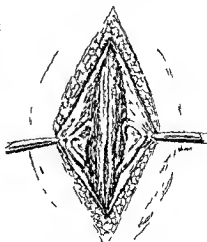


Fig. 5b Both round ligaments sutured in position

desired. Care should be exercised to avoid tying the round ligament sutures too tightly, otherwise necrosis will result and permit of the round ligament being drawn back unto the abdomen.

Postoperative care is the same as that in a case of an ordinary closed abdominal section with rest in bed for 2 weeks following operation and the avoidance of severe physical exertion for a period of 6 weeks thereafter.

#### ADVANTAGES

The advantages of this operation are

1. A certain amount of broad ligament tissue is pulled up and anchored with the round liga-

ment to the under surface of the oblique fascia thereby making the suspension a strong one.

2. All suturing of ligament is done outside the peritoneal cavity which eliminates factors favoring peritoneal adhesions.

3. The dimensions of the pelvic cavity are in no wise altered.

4. The possibility of obstruction due to the anchorage of ligaments in abnormal situations is obviated.

5. Long experience has demonstrated that it does not interfere with subsequent pregnancies.

6. Relapse of the displacement is but infrequently seen.

TECHNIQUE OF HYSTERECTOMY<sup>1</sup>

By F C DUBOSE MD FACS SELMA OKLAHOMA  
Vaughn M m 1H p 11

**C**OMplete hysterectomy by the method I shall describe is a safer operation than subtotal hysterectomy.

The median aponeurotic raphe between the inner margins of the levator ani muscle is the beam supporting the pelvic floor. The cervix uteri is not the keystone of the pelvic arch. The cervix is tumor bearing tissue and should be removed along with the neoplasm and uterus. Focal infections from the diseased cervix and its glands do occur not rarely as is claimed. Supravaginal amputation of the uterus is not as safe as a complete hysterectomy. If accidents follow the complete operation they are the result of faulty technique. Six vesicovaginal fistulae following hysterectomy were admitted to the Vaughan Memorial Hospital for operation during 1922 and 1923. No two were from the same surgeon and three states were represented. My associate Dr D H Doherty observed that we had escaped this distressing accident because of the free mobilization of the bladder forward off both the cervix and anterior vaginal fornix that the utilization of a fascial flap dissected off the cervical and vaginal area for closing the uterovaginal aperture in the pelvic floor had also prevented ptosis or prolapse of the vagina or of the remaining pelvic viscera that in his search of the literature he failed to find any description of similar technique which in our hands had given a degree of safety and satisfaction worth while to be made known. The tissue we had mistaken for fascia was a distinct muscle and as such had escaped description.

## ANATOMY

The structure to which attention is called in the female is the prototype of the levator prostate in the male. It has either escaped the attention of the anatomist or it has been dismissed with the terse description that the anterior fibers of the levator ani muscle descend upon the sides of the vagina. (In the male the anterior fibers from the levator ani muscle descend upon the sides of the prostate gland and unite beneath it with the same muscle of the opposite side supporting the prostate as a muscular sling.) Some anatomists describe it as a distinct muscle under the name of the levator prostate. Careful dissection in the female will demonstrate the same arrangement

of muscle fiber fusing with its fellow of the opposite side over the upper end of the vagina and the cervix uteri forming a ring for the cervix uteri on its anterior or under surface when it is normally anteverted. Furthermore these fibers are as distinct on the surface of the cervix in the female as on the prostate in the male. This muscle arises from the os pubis with the puborectals and follows its course backward and internal to it along the sides of the vagina converging over the anterior vaginal fornix and anterior surface of the cervix is inserted into the anterior surface of the cervix at the isthmus and fuses into the median aponeurotic raphe with the fibers of the same muscle of the opposite side. This median raphe is a strong fibrous or aponeurotic band extending throughout the midline portion of the uterovaginal attachment. On either side the connection between the uterus and the bladder is of loose areolar tissue and easily separated by blunt dissection in the lines of cleavage. Not so with the median attachment which is dense and firmly adherent holding the base of the bladder in a longitudinal line firmly attached to the cervix uteri which portion is separated with difficulty by blunt dissection. In a hysterectomy it is usually cut with scissors. This fibrous band of attachment between the bladder and uterus begins approximately 1 centimeter below the isthmus portio supravaginalis and extends downward and below on the vagina at its reflection on the cervix and between the vaginovesical attachment.

## SURGICAL ANATOMY

After the uterovesical plica of peritoneum is incised and blunt dissection of the bladder from the cervix uteri is begun it is found that lateral to the midline the dissection is easy the lines of cleavage being loose. In the midline the fibrous connection is dense and closely adherent between the bladder and the cervix uteri. So difficult is blunt dissection in this area that frequently it becomes necessary to incise this raphe. As a matter of fact it is always better after the dissection is done bilaterally to lift up this midline and cut the adherent tissue with scissors. As soon as this is done the bladder is pushed forward readily beyond the vaginocervical junction. An incision is made with the knife 2 millimeters in depth and a half centimeter below (when

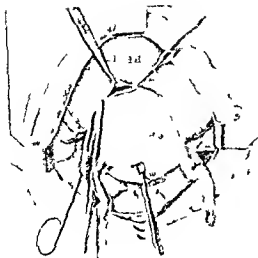


Fig 1

point is immediately below the isthmus) the cut edge of the peritoneum and carried transversely across the cervix

From this point in the incision blunt dissection will push downward and forward a second layer of tissue off of the anterior surface of the cervix and to a point on the anterior vaginal wall from 1 to 2 centimeters below its reflection on the cervix. If this band of tissue is lifted up and spread out over the handle of a knife examination will prove it to be muscular fibers which extend into and fuse with the levator ani muscle they are in fact its anterior fibers and form in the female the same sort of a sling for additional support of the cervix uteri that they do in the male for the prostate gland (3)

#### ANATOMICAL RESUME OF THE PELVIC DIAPHRAGM

| Muscles   | Fascia   |
|---|--|
| 1 Anteroposteriorly<br>Levator ani<br>Coccygeus<br>Pyridormus | 1 Sheaths of obturator internus, pyriformis and pelvic diaphragm |
| Laterally<br>Obturator internus                               | 2 The fascia associated with the pelvic viscera                  |

#### LEVATOR ANI

Anterior portion called (pubo-coccygeus) (pubo-rectalis) because of separate nerve supply the inferior hemorrhoidal branches of pudic nerve  
 Posterior portion called (ano-coccygeus) because of separate nerve supply anococcygeal nerve  
 Origin From pubic ramus spine of ischium and intervertebral obturator fascia  
 Course Downward and backward to midline of pelvic floor

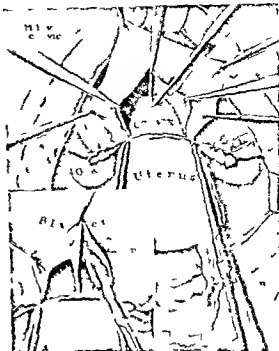


Fig 2

Incision Into last two segment of coccyx the ano-coccygeal raphy. The middle fibers into the side of rectum blending with the sphincter fibers. The anterior fiber descend upon the side of the prostate in the male and the cervix uteri in the female and unite underneath with the muscle of opposite side also joining the fibers of the sphincter externus and the transverse perineal at the central tendinous line of perineum. In this manner it forms a sling for support of cervix or prostate. This relation has caused the fibers to be called respectively levator cervicis uteri and levator prostate.

#### TECHNIQUE

A lower midline incision is made. Self retaining retractors are put in place. Vulsellum forceps are inserted into the fundus of the uterus. The uterus is pulled up into the operative field. The intestines are carefully packed off with gauze. The right fallopian tube is caught with forceps and held up. A Reverdin needle is inserted underneath the tube at the cornu of the uterus. A loop made in the margin of the tubal ligament. The ligature is tied and the tube is cut loose beyond the ligature. The needle is passed in the broad ligament to the inner side of the ovarian ligament emerging anteriorly underneath the round ligament. It is looped over the free border of the broad ligament and tied. A rat tooth clamp is applied close to the uterus and the tissue



Fig. 3

between the ligature and clamp is cut. A second ligature is passed through the broad ligament below the first small loop on the free border and tied. A clamp is placed close to the uterus and the tissue between this ligature and the clamp is cut. A similar procedure is done on the left side step by step (makes a figure of 8 with one large and one small loop). A small loop prevents the ligature from slipping. The lower part of the ovarian ligament is on a level posteriorly with lower edge of the round ligament anteriorly so that a suture passed from behind forward comes out immediately underneath the insertion of the round ligament and completely ties off the ovarian artery or blood supply of the two segments of the uterus. As soon as these two ligatures are placed one on the right and one on the left and the tissue between the ligatures in the broad ligament and clamp is incised into the uterus is so loosened that it can be drawn up into the operative field. The two lateral incisions are carried down to the reflection of the peritoneum from the bladder to the uterus on each side. The uterovaginal fold is incised transversely through the peritoneum. The peritoneal edge of the uterine vaginal fold is caught with a forceps and easily dissected by the handle of the knife or gauze covered finger from the anterior uterine

and cervical wall or surface except in the middle in front. The median raphe being firmly and rather densely connected is dissected free with a knife or scissors for a distance of an inch or an inch and a half. The bladder is thus easily separated from its cervical attachment and pushed forward. An incision is made with the knife 2 millimeters in depth and a half centimeter below (which point is immediately below the isthmus) the cut edge of the peritoneum and carried transversely across the cervix. From this point blunt dissection will push downward and forward a second layer of tissue off of the anterior surface of the cervix and to a point on the anterior vaginal wall from 1 to 2 centimeters below its reflection on the cervix. Thus is the levator cervicis muscle which has been described. The uterine vessels are next ligated by passing the Reverdin needle posteriorly through the peritoneal covered broad ligament into this raw space which has resulted from the dissection of the bladder and muscular sling from the cervix. A No. 2 The needle is passed close to the cervix. A No. 2 chromic catgut ligature is placed here by the figure of 8 method described above. This is done on both sides and the tissue between the cervix and the ligature incised. Clamping the uterine side of this area is unnecessary as very little bleeding results. The uterus is drawn still further up more easily because it is now held only by its insertion into the vaginal vault. This last ligature ties the uterine arteries and such branches of the uterine arteries as are not caught within this ligature can be seen readily from this area. This allows the broad ligament to drop well away from the uterus on each side.

The uterus is now free except for its attachment at the cervix uteri to the vaginal vault. When the uterus is drawn up the anterior vaginal wall at its reflection over the cervix is brought well into the operative field. This dissection as described frees the bladder very widely from the uterus and the method of ligaturing the broad ligament prevents the possibility of wounding or engaging the ureters in the ligatures. An incision is made posteriorly over the isthmus connecting the line of dissection with each other front and back. The peritoneum is peeled off the posterior wall of the cervix well over the vaginal reflection of the posterior vaginal fornix.

The anterior vaginal wall which is easily differentiated on account of its white and glistening appearance is caught close to its attachment to the cervix by two rat tooth forceps one just above the other and in the space between the

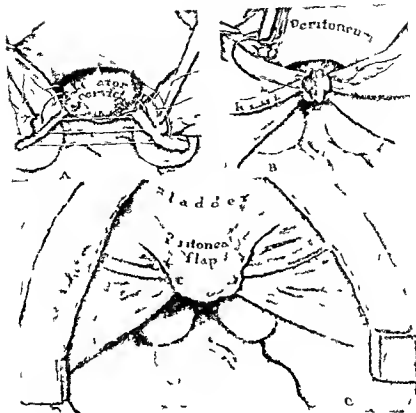


Fig 4

forceps the anterior vaginal fornix is incised and the vagina opened. The incision with either knife or scissors is carried around the cervix to separate the vagina from it care being taken to trim close to the cervix. As the vaginal wall is cut from and close to the cervix it is caught at intervals with forceps which act as haemostats as well as exert traction and prevent the vagina from prolapsing into the pelvic floor as soon as its attachment to the cervix has been completely severed. Thus the upper end of the vagina is wide open. It is disinfected either by tincture of iodine or mercuriochrome solution and then sutured.

The first sutures in the vaginal wall approximate only vaginal tissue and are interrupted figure of 8 sutures running from right to left or across the upper end of the vagina laterally. In this utmost care is used to catch the mucosa otherwise bleeding from vaginal vessels may occur. This suture line having been completed a mattress suture is placed in the vaginal wall opposite the base of the broad ligament on each side and tied. This inverts the sutured vaginal stump

and over this the levator cervicis is drawn and sutured laterally to the dome of the vagina and posteriorly to the vaginal wall and overlying peritoneum. This is the step that restores the musculature of the pelvic floor, and is not very dissimilar to the flap operation for umbilical hernia.

The cut edges of the broad ligaments are approximated from below upward by a series of mattress sutures. The lower loop of the first traversing the vaginal dome underneath the levator cervicis muscle. The second suture is so introduced that the round ligaments are united. The third holds together the upper borders of the broad ligament. The edge of the reflected uterovesical plica of peritoneum is pulled forward over the broad ligaments covering the suture line. The raw margins inverted and held in place by interrupted suture completely peritonizing all the raw surfaces in the operative field.

A small rubber wick is always placed in the lower angle of the wound for drainage of the pelvic peritoneal cavity. The case lost in the total



Fig. 3

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The uterus is now free except for its attachment at the cervix. When the uterus is drawn up the anterior vaginal wall at its reflection over the cervix is brought well into the operative field and the tightening of the vaginal wall presents itself. This dissection as described frees the bladder very widely from the uterus and the method of ligaturing the broad ligament prevents the possibility of wounding or engaging the ureters in the ligatures. An incision is made posteriorly over the isthmus connecting the lines of dissection with each other front and back. The peritoneum is peeled off the posterior wall of the cervix well over the vaginal reflection of the posterior vaginal wall which is easily reflected.

The anterior vaginal wall which is easily differentiated on account of its white and glistening appearance is caught close to its attachment to the cervix by two rat tooth forceps one just above the other and in the space between the

## IMPROVED OPERATION FOR CONGENITAL DEEP CUL-DE-SAC

By LEON GLASSMAN M D CHICAGO

F m th Gy cological D pa tm t f the Post G d t School d Ho p tal f Chicag

**I**N VIEW of the fact that cases of congenital deep cul de sac are not infrequent it is unfortunate that even in the most skillful hands the prognosis is far from favorable, and it is a matter of chagrin to the operator to have his cases return to him repeatedly for repairs.

A congenital deep cul-de sac is a condition in which the fibrous fatty tissue of the rectovaginal septum is partially or completely absent and because of this lessened amount of packing between the anterior rectal and the posterior vaginal walls the peritoneum during its further embryonal development fails to be pushed up from the contour of this channel to a normal level.

Diagnosis of congenital deep cul de sac the true congenital posterior vaginal hernia is described by my chief Dr Emil Roesl in his article "A New Operation for Prolapse of Uterus" in which he states

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In the course of the abdominal part of prolapse operations I have repeatedly been able to demonstrate that the peritoneum may reach clear to the perineum so that rectum and vagina are entirely separated. Also I have learned to diagnose these cases before operation. Of course when the pouch of peritoneum contains bowel in the typical hernia fashion it can be diagnosed, but I have never seen such an extensive case. I diagnose them now by introducing one finger into the rectum and taking hold of the protruding vaginal wall with the other hand. When now the vaginal wall is pulled upon the rectal wall does not follow in these cases as it does in simple rectocele.

While this condition is now quite readily recognized the treatment remains uncertain. Of all procedures the most plausible theoretically is that of Ashton<sup>2</sup>

After opening the abdomen the fundus of the uterus is seized with bullet forceps and pulled upward into the abdominal incision. A careful incision is then made. The sac is pulled out of the false canal, seized with long-bladed hemostatic forceps and tightly twisted upon itself. The sac is then ligated with a silk ligature (No. 32) and the redundant portion cut off. If the sac cannot be pulled out of the false canal on account of adhesions the

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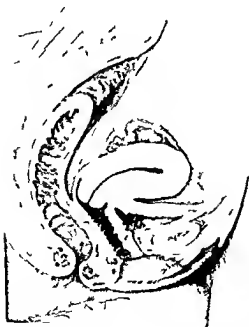


Fig 1 A drawing showing the position of a normal cul-de sac



Fig 2 A congenital deep cul-de sac with peritoneum extending nearly to the perineum.



SURGERY GYNECOLOGY AND OBSTETRICS

hysterectomy group was the only one in the series in which the drain was not introduced. Hypodermoclysis of glucose 15 per cent in normal saline, one liter introduced during operation is a routine procedure. A plain hot water clyster is used after Clark's method. Infiltration of lower midline with one fourth of 1 per cent apothecine solution permits incision of abdominal wall while patient is being anesthetized and prevents shock from retraction on abdominal wall. Nitrous oxide oxygen or ethylene oxygen is the usual general anesthetic rarely indeed ether and then used only during the deeper pelvic part of operation. The average operating time including count is 45 to 60 minutes. The layer method of hysterectomy is the layer method.

The average operating time in the laparoscopic approach was 40 minutes. The abdominal incision was closed by the layer method and the parietal peritoneum being care

The abdomen is closed by suturing the edges of the parietal peritoneum fully everted. This technique has no place in operations for cancer of the cervix.

Summary of cases

## SUMMARY OF CASES

SUMMARY OF CASES

In our service at the Vaughan Memorial Hospital in 5 years from 1920 to 1924 inclusive (Table I), there were 108 hysterectomies done

SUMMARY OF HYSTERECTOMIES FROM 1920 TO 1924 INCLUSIVE

TABLE 1—SUMMARY OF HYSTERECTOMIES  
1920 TO 1924 INCLUSIVE

|                | Tot<br>by                                | by                | by                     | by                  | Tot<br>by |
|----------------|--|-------------------|------------------------|---------------------|-----------|
| W mbc          | 50                                       | 5                 | 7                      | 75                  |           |
| R th           | 55                                       | 6                 | 7                      | 78                  |           |
| D th           |  |                   |                        |                     |           |
| M t by         |  |                   |                        |                     |           |
| C ne f<br>d th | P lm<br>bols m<br>pols m<br>Sep t<br>n d | ry m<br>pe<br>t d | Septem<br>ber 1<br>F m | to 12<br>p b<br>sep |           |

from 1921 to 1924 inclusive  
at the Burwell Hospital  
for the Burwell service

In the four years from 1921 to 1924 inclusive in Doctor Doherty's service at the Burwell Hospital there were 71 hysterectomies. In both services there were 163 total hysterectomies, 16 subtotal and 7 vaginal. In the entire number there were four deaths. The sepsis case was the only case in the entire series which was not drained at time of operation and died of septic peritonitis. The one under subtotal hysterectomy which died from septicaemia had double pus tubes and had

**Y AND OBSTETRICS**

postoperative ileus When the abdomen was reopened multiple abscesses were found in the pelvic cavity The puerperal septicemia case was not operated on until 48 hours after curing the uterus when hysterectomy was advised and refused by family and attending physician consent being given when it was apparent that the patient was going to die

**COMMENTS**

Contribution to present definition

## COMMENTS

ing given a  
was going to die

COMMENTS

It is the purpose of this contribution to present a technique for hysterectomies on well defined anatomical lines the dissections in this identity and isolating the structures in the operative field clarifies that area called parametrial tissue. The incidence of accidents to the ureters and bladder and the sequence of ptosis or prolapse of the pelvic viscera following hysterectomy will be either greatly lessened or avoided altogether. The statement that total hysterectomy is the operation of choice and safer than subtotal hysterectomy is true provided that total hysterectomy is done along the plans outlined above and not surely not according to the generally accepted present day technique. The element of individual skill is entirely ignored for when a certain level among accredited surgeons is reached this factor is small indeed. To illustrate of the cases here presented 97 were done by my associate Dr D H Doherty in the Burnell Infirmary and to further confirm these apparently extravagant claims there are reported in SURGERY GYNÆCOLOGY AND OBSTETRICS December 1925 162 subtotal hysterectomies with 9 deaths in uterine fibromyomata 14 subtotal hysterectomies with chronic pelvic infections with 3 deaths. In this entire series there were three uterine fistulae and one vesicovaginal fistula.

We are convinced from our own experience that the operation of hysterectomy done by this method is safer than a subtotal hysterectomy. The remote results the recurrence of neoplasia incidence of cancer in retained cervix are avoided irritative or troublesome leucorrhœa are avoided.

REFERENCES

Went Dore Gynec &

We are convinced that the operation of hysterectomy by the method is safer than a subtotal hysterectomy. The remote results, the recurrence of neoplasm, incidence of cancer in retained cervix and an irritative or troublesome leucorrhoea are avoided.

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FIG. 9. Abdominal view with the uterus held forward. The incision in the vertical peritoneal sac previously incised through the vaginal route is immediately noticed between uterus and rectum. The peritoneal sac drawn with forceps farther up into the peritoneal cavity. The peritoneal sac is obliterated with a suture ligation at its base at the approximate level of a normal cul de sac and will be cut off above the ligation as indicated by the dotted line.

opening should be closed with interrupted silk sutures (No. 7) at the normal level of Douglas's cul-de-sac.

But we have conclusively demonstrated that this method is not feasible. The peritoneum cannot be separated from its attachments and will not peel off so as to enable the operator to twist it upon itself in the described manner nor in fact in any manner whatsoever.

Aside from method which must be abandoned because of their non-feasibility, we find that other procedures although obliterating the cul de sac at the time of operation do not prevent the recurrence of the malformation. If we accept a congenital deep cul de sac as analogous to an inguinal hernia, we conclude that obliteration of the peritoneal sac is the primary step in its treatment. But this obliteration must be at a nearly normal level and be permanent.

In order to achieve the two considerations, namely (1) the obliteration of the cul de sac at a nearly normal level and (2) the permanence

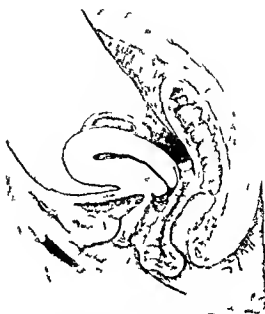


FIG. 10. Cul de sac at the normal level with ligated inferior stump of peritoneal sac. The three fine catgut sutures between the vagina and the rectum for obliteration of the space between both.

of this obliteration I devised an operation. This operation requires both vaginal and abdominal work, thereby obtaining the great advantages of securing the peritoneal sac from below and of permitting the use of it as a safe guide in the abdominal work.

The vaginal operation consists of an incision of any shape on the posterior vaginal wall which will permit entrance into the deeper structures, the denudation of the vaginal mucosa and the excision of the redundant portion of the mucosa. Underneath this mucosa and in front of the rectum the peritoneal sac is found. The sac is bluntly dissected from its attachments up to the required level which should be approximately 7.5 centimeter from the perineum. The freed peritoneal sac is picked up with forceps and may be inverted without being incised. The incising of the sac at this time however offers several advantages:

1. Demonstration of entrance into the free peritoneal cavity. (The exposed peritoneal surface is recognized by its shiny appearance.)

2. Digital exploration of the sac.

3. Easier handling of the sac if further dissection is required.



Fig. 3



Fig. 4



Fig. 5



Fig. 6

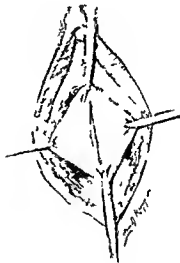


Fig. 7



Fig. 8

Fig. 3. Raised flap of posterior vaginal mucosa ready for excision. The sac is seen lying underneath.

Fig. 4. Complete excision of the flap of the posterior vaginal mucosa. The upper cut edge is held by a retractor. The perineal area is seen adjacent to the rectum.

Fig. 5. The incised margin of the pentoneal sac is being bluntly separated from its attachment to the rectum.

Fig. 6. Completely freed pentoneal sac held up by a forceps.

Fig. 7. The freed pentoneal sac held in tension by a forceps and incised at its lower pole. The incised pentoneal surface is recognized by its inner surface.

Fig. 8. The incised margin of the pentoneal sac held up by a forceps and pushed up into the cul-de-sac.

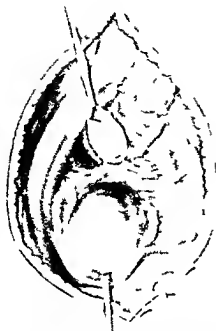


FIG. 9. Abdominal view with the uterus held forward. The inverted peritoneal sac previously incised through the vaginal route is immediately noticed between uterus and rectum. The peritoneal sac drawn with ligature farther up into the peritoneal cavity. The peritoneal sac is blunted with a suture ligature at its base at the approximate level of a normal cul-de-sac and will be cut off above the ligature as indicated by the dotted line.



FIG. 10. Cul-de-sac at the normal level with ligature inverted stump of peritoneal sac. The three fine catgut sutures between the vagina and the rectum for obliteration of the space between both.

opening should be closed with interrupted silk suture (No. 1) at the normal level of Douglas's cul-de-sac.

But we have conclusively demonstrated that this method is not feasible. The peritoneum cannot be separated from its attachments and will not peel off so as to enable the operator to twist it upon itself in the described manner nor in fact in any manner whatsoever.

Aside from method which must be abandoned because of their non-feasibility, we find that other procedures although obliterating the cul-de-sac at the time of operation do not prevent the recurrence of the malformation. If we accept a congenital deep cul-de-sac as analogous to an inguinal hernia, we conclude that obliteration of the peritoneal sac is the primary step in its treatment. But this obliteration must be at a nearly normal level and be permanent.

In order to achieve these two considerations, namely (1) the obliteration of the cul-de-sac at a nearly normal level and (2) the permanence

of this obliteration, I devised an operation. This operation requires both vaginal and abdominal work, thereby obtaining the great advantages of securing the peritoneal sac from below and of permitting the use of it as a safe guide in the abdominal work.

The vaginal operation consists of an incision of any shape on the posterior vaginal wall which will permit entrance into the deeper structures, the denudation of the vaginal mucosa and the excision of the redundant portion of the mucosa. Underneath this mucosa and in front of the rectum the peritoneal sac is found. The sac is bluntly dissected from its attachments up to the required level which should be approximately 7.5 centimeters from the perineum. The freed peritoneal sac is picked up with forceps and may be inverted without being incised. The incision of the sac at this time however offers several advantages:

1. Demonstration of entrance into the free peritoneal cavity. (The exposed peritoneal surface is recognized by its shiny appearance.)

2. Digital exploration of the sac.

3. Easier handling of the sac if further dissection is required.

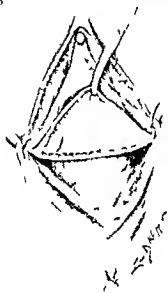


Fig. 3



Fig. 4



Fig. 5



Fig. 6

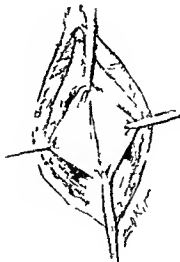


Fig. 7



Fig. 8

Fig. 3 Radical posterior vaginal mucous membrane dissection. The sac is seen from underneath.

Fig. 4 Complete excision of the fistula of the posterior vaginal mucous membrane. The upper cut edge is held back at the rectum. The peritoneal sac is then adherent to the rectum.

Fig. 5 The lower pole of the peritoneal sac being bluntly separated from its attachment to the rectum.

Fig. 6 Completely freed peritoneal sac held up by forceps. The fixed peritoneal sac is held up by forceps and is seen at its lower pole. The exposed peritoneal surface is recognized by its shiny surface.

Fig. 7 The incised margin of the peritoneal sac is held with forceps and pushed up into the cul-de-sac.

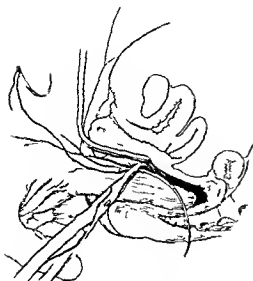


Fig 1

The sutures are tied rather tight over a folded gauze compress. The gauze may be kept dry by covering with rubber dam sealed to the skin with narrow strips of adhesive which are protected from moisture by painting with rubber cement.

The child is kept in bed for 3 or 4 days during which time bowel movements are prevented by small doses of paregoric twice daily. When it is desired to move the bowels an enema of 3 or 4 ounces of warm olive oil is given at night to be retained and milk of magnesia is given the following morning.

The sutures are removed at the end of 2 weeks.

The efficacy of this method lies in the well known tendency of silkworm gut to cut its way through the tissues when under tension. As the suture slowly cuts through the rectal wall and perirectal tissues healing by granulation follows in its track with the formation of firm connective tissue adhesions.

It seems probable that a simple procedure like this must have been used by others before me but I have not seen the method described.

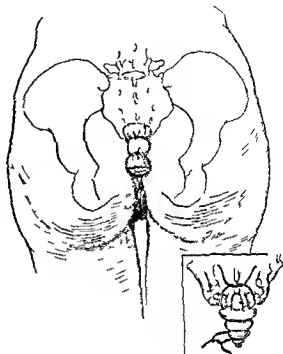


Fig 2

NOTE.—Since the above was written an article by G. Petren in *Acta Chirurgica Scandinavica* (1925, lxx, 1<sup>o</sup>—205) Remote Results after Rectopexy à la Lækehorn for Rectal Prolapse in Children came to the notice of the writer. Petren reports 26 cases of rectal prolapse in children operated on at the Lund Clinic with uniform ultimate success by the method of rectopexy originated by Lækehorn of Sweden with an average hospital sojourn of 18½ days.

Lækehorn's operation while the same in principle differs from the technique here described in that a single heavy silk suture is used and the needle is introduced from the skin surface into the rectum and the operator's finger which guides the needle out to the anus where it is threaded and retracted the process being repeated on the other side of the coccyx.

Petren mentions the occurrence of moderate general and local reaction in most cases with temperatures of 33 degrees C. to 39 degrees C. This reaction may have been the result of the heavy silk suture acting as a wick and carrying infectious material from the rectum into the perirectal tissues.

The incised margin of the peritoneal sac is grasped with forceps inverted and pushed up into the cul de sac. The forceps are gently withdrawn. If necessary this temporary inversion of the peritoneal sac may be reinforced and supported by a small sponge introduced into the sac. This sponge is later removed through the abdominal procedure. With two or three very fine sutures the space between the vagina and the rectum is obliterated. A high attachment of the vagina on the rectum is not required as the redundant amount of vaginal mucosa has been excised and there has been no prolapse of the rectal wall. As a rule prolapse of anterior rectal wall (rectocele) is not associated with a congenital deep cul de sac.

If this congenital cul de sac should have become complicated with lacerations of the levator ani muscles then these muscles will have to be brought together with several interrupted sutures.

The closure of the opening in the posterior vaginal wall is accomplished with a simple continuous catgut suture approximating the margins of the vaginal mucosa.

This is immediately followed by the abdominal procedure which after the opening of the abdomen placing the table in Trendelenburg position and packing off the bowel requires the uterus to be pulled up thereby bringing the cul de sac into better view.

Immediately the incised edge of peritoneum that was inverted through the vaginal route is noticed. If a small sponge was used from below as a support it is now withdrawn.

The freed incised peritoneal sac is grasped with forceps drawn farther up into the peritoneal cavity and ligated with a suture ligature at its base at a level of a nearly normal cul de sac. The sac of peritoneum above the ligated point is cut off. Other work in the abdomen that may be required is now done.

## A SIMPLE, BLOODLESS OPERATION FOR ANORECTAL PROLAPSE IN CHILDREN

By C. L. HIRSH, M.D., F.A.C.S., Cedar Rapids, Iowa

**A**NORECTAL prolapse is rather common in children and some cases can be cured by careful constant attention on the part of the mother or nurse for several ometimes many weeks. Correction of intestinal irritation stripping the buttocks with adhesive maintaining the recumbent position in defecation and in some case supporting the perineum and anus during defecation are essential. After apparent cure careful watching to prevent recurrence is necessary for months (Kerley). Such management is arksome and disagreeable and often it is impossible to have it effectively carried out.

Linear cauterization of the rectal mucosa and muscular wall with the actual cautery is successful in some cases. This procedure is usually followed by severe pain requiring opiates for its relief and prolonged careful management is necessary during the slow healing process. Any method depending on considerable destruction of tissue with consequent contraction of cicatrices is obviously objectionable.

I have found the following simple procedure to be all that one could desire in the cure of this troublesome condition.

The intestinal tract is evacuated with milk of magnesia the day before and by enemata 2 hours before the operation.

Under ether or ethylene anaesthesia the child is placed in the dorsal position its legs being supported by an assistant. After the prolapsed bowel is reduced a small bivalve rectal speculum is introduced the blades spread laterally and the lower rectal mucosa swabbed with a percent aqueous solution of mercurochrome. A small rectal retractor on the anterior rectal wall may be used instead of the bivalve speculum.

The index finger is inserted and the notch or angle at the junction of the coccyx and sacrum is located.

A 3 inch with a  $\frac{3}{8}$  circle curved needle on one end of a coarse silkworm gut is passed along the finger in the rectum inserted through the posterior rectal wall through the notch at the sacrococcygeal angle and out through the skin posteriorly. A needle on the other end of the suture is passed in the same manner at the same point on the opposite side of the coccyx. A second similar suture is placed one half inch lower emerging on each side of the coccyx.

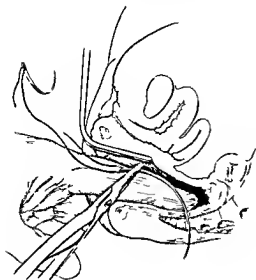


Fig 1

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The sutures are removed at the end of 2 weeks. The efficacy of this method lies in the well known tendency of silkworm gut to cut its way through the tissues when under tension. As the suture slowly cuts through the rectal wall and perirectal tissues healing by granulation follows in its track with the formation of firm connective tissue adhesions.

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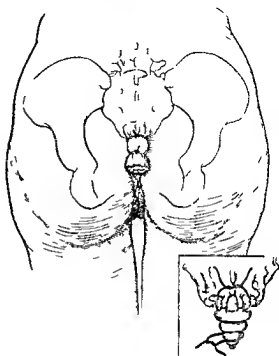


Fig 2

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## A SKELETAL TRACTION CLAMP PERMITTING FULL EXTENSION OF THE EXTREMITY

BY J. ALBERT KEE, M.D., ST. LOUIS, MISSOURI

OF late years skeletal traction has been used extensively both in this country and abroad. The fact that it has been used successfully in a great number of cases would indicate that it can be used in the average surgical clinic with relatively little danger of infection to the bone. In cases in which considerable force is necessary, experience has shown that skeletal traction is more efficient than skin traction. Not only is it more efficient but when properly applied it serves to make the patient more comfortable than it is possible to make him during a similar period when he is subjected to an equal pull by skin traction.

Therefore we believe that skeletal traction should be used routinely in most cases of fracture of the shaft of the femur in adults and in other cases in which a strong pull is indicated, such as the pulling down necessary in an old dislocation of the hip preliminary to operation, the lengthening of an extremity after plasticotomy, etc. The only objection to skeletal traction is that its application necessitates a surgical operation, while skin traction does not. In a well equipped hospital the operation can be quickly and safely done under either general or local anesthesia and we feel that the increased efficiency and added comfort to the patient more than outweigh this slight disadvantage.

The usual methods of applying skeletal traction are by the Steinmann pin, the Pear or tongs, or the Finocchietto stirrup or by some modification of one of these.

In most cases we have used a modification of the Pearson ice tongs. But in November of 1914 we had a case in which the ice tongs could not be used. The patient was admitted to the hospital with a paralytic dislocation of the right hip and a flexion contracture of the right knee. The knee was straightened by wedging plasters and skeletal traction was applied to the femur to pull it down preliminary to an arthrodesis of the hip. It was important to maintain the knee in extension. This could not be done with the ice tongs which we were then using, therefore a traction clamp was devised and put on the patient in place of the tongs.

Since our clamps were made a modification of the ice tongs in general use has been devised and

published by Langworthy.<sup>2</sup> The clamp we describe here is simpler and more efficient.

The assembled clamp is shown in Figure 1. The details are shown in Figures 2, 3, 4, and 5. The piece shown in Figure 2 is made of a square rod of Jersup's steel roughly 16 inches long. One end is sharpened to a long slender point and the other end is rounded and threaded for a distance of 4½ inches. It is then bent as shown in the figure and a large steel chain link is placed around the base of the line and is brazed in position. The link projects directly forward at right angles to the plane in which the rod is bent and the point is bent forward about 5 degrees.

To make the piece shown in Figure 3 a piece of square steel rod 6 inches long is sharpened at one end and bent and a link fitted as in Figure 2. The other end is then brazed to a piece of square steel tubing 6 inches long. The rod and the tube are at right angles to one another. This joint is made very strong by splitting two edges of the tube for a short distance and turning one side down. The rod is then placed in the notch in contact with the opposite side (top) of the tube and brazed solidly in position. A hole is then drilled in the rod in the end of the tube to permit the passage of the threaded end of the piece shown in Figure 2. Near the other end of the steel tube a hole is drilled in the side opposite to that from which the rod projects. A threaded nut is brazed in position over this hole and a thumb screw is fitted into the nut.

To assemble the clamp we push the long end of Figure 2 through the steel tube of Figure 3. A thumb nut is then put on the threaded end. By means of this nut the clamp may be tightened at will and by means of the thumb screw in the top of the tube it can be set in any position. When the thumb screw is tightened the clamp is rigid.

*Second type of clamp.* For use with drills or pins passed through the bone we have had clamps made in which instead of the points about half an inch of the rod is turned in and drilled with a hole large enough to admit the end of the pin or drill used in the bone. The details of this construction are shown in Figures 4 and 5. Figure 4 is a view from the inside showing the drill hole in the end of the rod and the manner in which it is

Fig. 1. Assembled clamp. Fig. 2. Detail of rod and link. Fig. 3. Detail of rod and tube joint. Fig. 4. Detail of drill hole in rod. Fig. 5. Detail of thumb screw and nut.

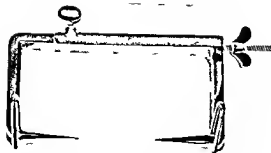


Fig 1 Drawing showing assembled clamp

link fits over the rod. Figure 5 is a view from the outer side and is the same for both types.

When finished the instrument is nickel plated. The dimensions in the figures are taken by the artist (Mr. Conrath) from a completed clamp and may be altered at will. Our clamps are made in the mechanical shop at the Washington University Medical school.

In applying the traction clamp the procedure is similar to that used in putting on ice tongs. For the femur the skin is pulled up and an incision is made down to the bone at a point about one half inch above and anterior to the adductor tubercle. The periosteum is cut for a distance of about half an inch. A similar incision is made at a corresponding point on the lateral side of the thigh. The sterilized clamp is then assembled loosely and with the body of the clamp projecting anterior to the thigh the points are thrust into the bone. The thumb nut is then tightened forcing the points still further into the bone. If one desires the points may be hammered in. When the desired depth of penetration is reached the thumb nut on

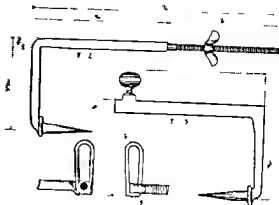


Fig 2 to 5 Drawing showing parts of clamp

the tube is tightened and the clamp is thus locked in position.

It will be to slip the ring of the Thomas splint over the leg before applying the clamp as the ring may not be large enough to pass over the clamp when in position. After the clamp is in position it is advisable to enlarge the skin incision below the clamp for a distance of about half an inch to prevent pressure on the skin when traction is applied. The wound is now covered with a thick dressing of gauze soaked in some non irritating antiseptic solution. A saturated alcoholic solution of picric acid is efficient. This is covered with a bandage and the leg adjusted in the Thomas splint.

For applying the traction we use a single rope or chain long enough to pass 6 inches beyond the foot and back to the clamp on the other side. This rope is passed through each end of a metal spreader and the two ends are tied to the links on the clamp. The main traction rope is then passed over the pulley at the foot of the bed. When heavy traction is used it is always advisable to raise the foot of the bed to relieve some of the pressure on the ischium by the body weight and also to have a small overhead traction to hold the ring snugly against the ischium. A foot piece should be used to prevent foot drop and in many instances it is advisable to have a hinged leg piece on the Thomas splint to permit movement in the knee. If one prefers intrinsic traction rather than the weight and pulley this can be used with the traction clamp and spreader and ordinary Thomas splint. If the clamp becomes loose after a time it can be tightened by releasing the thumb screw and tightening the thumb nut. It is important to leave the original antiseptic dressings in place until the clamp is removed. Frequent dressing courts infection. For this reason the points of

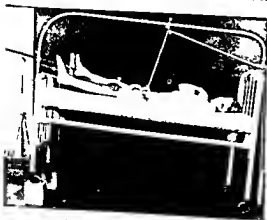


Fig 6 Traction clamp in use

the clamp are made unusually long to permit adjustment of the traction ropes without disturbing the dressings around the points.

In children we always use a pin or drill through the shaft of the bone because of the danger of pulling off the epiphysis by heavy traction. For this purpose we use the second type of clamp described with the holes in place of the tines (Fig 6).

Our first clamps for this purpose were lighter and simpler to make. The square rod and sleeve tubing are replaced by two flat steel bars. In one of these two holes are drilled and threaded

and thumb screws fitted. A channel wide enough to admit the screws is cut in the other horizontal bar. This clamp is fitted over the ends of the drill in the bone and locked in position by tightening the screws. This apparatus lacks the screw adjustment for tightening the clamp, but for pin traction it is quite as efficient as the more expensive type.

Figure 6 is a photograph of the traction clamp in use. This patient, a boy twelve years of age, had had 30 pounds traction for 3 weeks. After the photograph was taken, 10 more pounds were added with no ill effects.

## A PLASTIC OPERATION FOR REDUCTION OF OLD TRANSVERSE FRACTURES OF THE DISTAL END OF THE RADIUS, HEALED WITH DISPLACEMENT AND DEFORMITY

BY LAWSON THORNTON, M.D., ATLANTA, GEORGIA

**F**RACTURE of the distal end of the radius in children almost always takes place transversely through the newly formed bone adjacent to the epiphysis. Displacement of the upper fragment may be either backward or forward. If backward the periosteum is stripped from the anterior aspect of the shaft of the bone. If forward it is separated from the dorsal surface. A triangular space is thus formed between the periosteum the cortex of the upper fragment and the fractured surface of the distal fragment. If for any reason the fracture is not reduced this triangular area becomes filled with new bone within a very short while and then reduction can be done only by an open operation.

Old healed fractures of this type with deformity either of anterior or posterior displacement are not infrequently presented to the surgeon for reduction. Removal of the callus in the subperi-

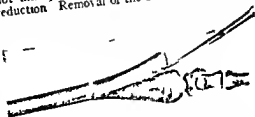


Fig. 2. Drawing shows a section of the distal shaft of the radius healed along the line of cleavage between the old and the new bone.

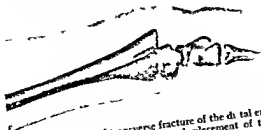


Fig. 1. Drawing of transverse fracture of the distal end of the radius healed with posterior displacement of the upper fragment. The triangular area between the cortex of the upper fragment, the fractured surface of the distal fragment, and the periosteum of the upper fragment is filled with callus.



Fig. 3. The distal section of the radius, swung on its osteoplastic alignment. The triangular callus is thus permitted to serve as a part of the distal end of the shaft.

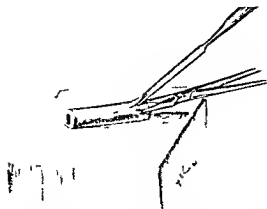


FIG. 4. The removed section of the original shaft of the radius is carved upon a wooden block in such a fashion that it will fit accurately into the triangular space from which it was taken.

osteal triangle described above plus refracture and reduction is not easily executed.

The method pictured in the accompanying illustrations is a more simple plastic procedure and restores normal anatomical position. In case of



FIG. 5. The plastic operation complete. The replaced section of bone is held in place by a snug periosteal closure.

posterior displacement of the upper fragment the incision is made on the dorsum of the forearm. An anterior incision is made in case of anterior displacement of this fragment. The bone is exposed by subperiosteal dissection.

The drawings show the details of the plastic sculptural procedure. The arm is immobilized in a plaster of Paris cast extending from the fingers to the axilla with the elbow flexed. Postoperative roentgenograms should be made at intervals to keep a check up on the alignment. Immobilization in a cast for 6 weeks is usually required until firm bony union has occurred.

# SURGICAL REMOVAL AND PATHOLOGICAL STUDY OF A MASSIVE SQUAMOUS CELL EPITHELIOMA ASSOCIATED WITH ANGIOMA OF THE SCALP<sup>1</sup>

BY D. SCHUYLER PULFORD, M.D., ROCHESTER, MINNESOTA

Section Surgeon 1st Lt. U.S.A.

AND

ALFRED W. ADSON, M.D., ROCHESTER, MINNESOTA

Section A 1st Sgt. U.S.A.

A MALIGNANT growth developing in an angioma is usually an endothelioma and is never epithelial in nature. Of 200 tumors of the blood vascular system reported recently by Pulford, 183 were benign angiomas, 9 were endotheliomas, and eight angio-endotheliomas. Pulford reported a case and presented photomicrographs showing the transition from benign angioma to malignant angio-endothelioma. Numerous reports can be found in the literature describing malignant change in moles, warts, sebaceous cysts, and the affected tissues in keratosis and leucoplakia. These are all recognized now as types of epitheliomas, although the pigmented ones were long thought to be mesenchymal in origin and called melanotic sarcomata.

Caylor has recently reported a series of 236 cases of sebaceous cyst of which 63 were of the scalp. Three of the patients had developed squamous cell epithelioma, two of grade 1 and one of grade 3.

The case herein reported is of interest from the pathological standpoint since it illustrates a malignant squamous cell epithelioma arising from the epithelium overlying a benign angioma, and because although approximately one half of the tumor was angiomatous, the malignant growth was not an angio-endothelioma as might have been expected, but an epithelioma arising from the epidermic elements overlying the vascular growth. The epithelium overlying an angioma usually undergoes hyperplasia, espe-



Fig. 1. Grade 1 squamous cell epithelioma on a massive angioma of the scalp.



Fig. 2. Granulating wound following removal of outer table of bone.



Fig 3 Calcareous deposit in fibroangiomatous area of the scalp (x60)



Fig 4 Pearl formation and almost complete differentiation in grade 4 squamous cell epitheloma of the scalp (x60)

cially when the angioma is large. This hyperplasia may be the result of irritation or of pressure or may be a protective process. In this case hyperplasia has gone on to malignant change. This case is of further interest from the surgical point of view since it had lasted 9 years and had been considered malignant and inoperable on account of its extensiveness and its hemorrhagic character.

#### REPORT OF A CASE

**CASE.** A woman aged 56 entered the clinic in March 1924 complaining of a growth on the head. There was no history of syphilis and no family history of malignant disease or tuberculosis. In 1909 when she was 45 years of age she noticed a small lump on the back of her head. It gradually grew larger until 14 months later the discharge of an indurated thick calcareous material was followed by almost complete disappearance of the tumor. Eleven years later the swelling reappeared in the same area and again increased in size. Twelve years before her admission to the clinic the growth of the tumor became much more rapid and it had attained its size. There were intermittent pains in the region of the growth but they did not radiate. She had had headache, visual disturbance, nausea, vomiting, and had observed no other tumor. Ulceration and secondary infection of the tumor had been present for several years. She had become quite weak and capillary but had not recently lost weight.

When seen she admitted these 13 years fairly good health and was thin but was pale and weak. From the nape of the neck was a band outward over the occiput to the right side, half an inch wide, infected, foul, oozing, and malodorous. It was 12 centimeters in diameter and was covered by many small projecting nodules all of which were freely vascular. The temperature was 99.2 degrees Celsius, pulse rate 84, the systolic blood pressure 152 and the diastolic 80. The urine showed a trace of albumin, occasional erythrocytes, and 30 pus cells to the field. The hemoglobin was 55 per cent, the erythrocytes numbered 3,390,000 and the leucocytes 11,000, the color index being

0.8. Roentgenograms of the chest were negative but those of the skull showed a soft tissue tumor attached to and thickening the occipital bone and attended by the formation of new bone giving ground for a suspicion of malignant disease. Neuropathic examination was entirely negative. A tentative diagnosis of a secondary malignant process of a sebaceous cyst was made and surgical removal was attempted (Fig. 5).

Radical operation was not undertaken without carefully weighing the risks and difficulties. The patient was 56 years of age in appearance much older, anemic and very weak. The tumor was large and contained numerous large vessels which extended from the scalp. It had apparently caused some resorption of the occipital bone which meant either erosion or invasion of the bone which in turn would necessitate removal of the tumor and tissues at least down to the skull itself. Treatment of this denuded bone with the object of stimulating granulation and epithelization would probably be difficult and lengthy. In order to avoid too great surgical shock and prevent hemorrhage the operation was performed under local anesthesia by the infiltration method and the bleeding was prevented by use of the Heidenhain suture that is a continuous suture of catgut placed around the periphery in such a manner as to compress the entire thickness of the scalp. The first suture was tied while the remaining sutures were placed in running fashion from the surface of the skin to the pericranium. The needle always emerging 2 centimeters from its point of entrance and entering the skin half way between that point and that of the previous entry. Following operation every alternate suture was cut in order to relieve some of the compression of the scalp and in this way large vessels were tied. On the second day after operation all of the catgut was removed. The tumor was elevated by electrocautery, the incision being carried through the skin well beyond the boundary of the tumor and through the galea and the perosteum of the skull so as to permit removal of the tumor en masse with the perosteum. The resorption of the skull was due to pressure erosion and not invasion so that the entire tumor would be elevated with the perosteum. After the tumor had been freed from the vertex and occiput it was turned backward over the nape of the neck. The removal was completed by

of muscle with the tumor. Cautery was used for the entire removal. There was practically no bleeding and the patient experienced no pain. The larger veins and arteries were tied to prevent subsequent hemorrhage. The wound was then covered with bone acid powder and a dry dressing was applied. In view of our former experience with denuded bone we undertook on the sixteenth day after operation and without using any anesthetic the removal of the outer table from the posterior portion of the parietal and occipital bones in order to expose diploë which would produce granulating tissue. This wound was covered with an alcohol dressing until there was an even granulating surface and then instead of grafting skin paraffin was applied as is so frequently done in the treatment of burns; that is the granulating tissue was covered daily with a coat of paraffin and protected by a white basket especially constructed to prevent the grime from rubbing the paraffin. Since skin grafting would have necessitated the patient's remaining in hospital for a protracted period she was permitted to return home under paraffin treatment. Her convalescence was uneventful and satisfactory and there was complete epithelization of the denuded area without any evidence of recurrence.

The specimen consisted of a rough hard ulcerated infected mass with normal skin and hair on the margins and with the occipitofrontalis fascia and some muscle on the under surface. Most of the upper surface was studded with tuberos growths about 0.5 to 3 centimeters in diameter with ulcerated tissue between. The cut surface showed multilocular cysts and channels some filled with blood and others with gelatinous or with caseous material. The tumor measured when fixed in formalin 21 by 19 by 9 centimeters and weighed 1552 gram.

Many sections taken through different parts of the tumor showed that the tissue was about equally divided between fibro-angiomatous tissue and a warty epithelial structure. The cavernous nature of the angiomatous areas together with the associated dense fibrous tissue bands established the benignancy of this part of the tumor. Growth and proliferation of the squamous epithelium however was quite active and in some areas actual squamous cell epithelioma was found. The large amount of completely differentiated squamous epithelium seen in the form of cholesterolomatous masses and the almost complete differentiation of the squamous epithelium throughout placed the tumor in the lowest grade of Broders' classification of malignancy that is grade 1. There was an attempt on the part of nature completely to eradicate the keratin masses of differentiated epithelium by depositing calcium in and about them enough for the roentgen ray to cast a shadow.

The interesting feature of this tumor from the pathological standpoint is that although the bulk of it was at first angiomatous the malignancy

developed in the overlying epithelial structures producing a squamous cell epithelioma instead as might have been expected a tumor of fibrous tissue or endothelium. The fact that it might have started on a sebaceous cyst to be later overshadowed by telangiectasia is to be remembered. Although there is often epithelial hyperplasia over an angioma of the skin it rarely becomes malignant. This case also illustrates how little the diagnosis of malignancy helps in prognosis unless the tumor is graded and the degree of malignancy stated. This patient had been told repeatedly by various physicians over more than a score of years that she had an incurable tumor that it was malignant and that there was no hope for her. A biopsy showing the malignancy to be grade 1 would have prompted earlier operation and would have saved the patient much pain worry and expense.

The term naevus epitheliomatosis is avoided in this case as this term applies to a wart or a mole which has become malignant. The tumor under discussion arose from a sebaceous cyst or an angioma.

#### CONCLUSIONS

1. Surgical shock can be minimized by the use of local anesthetics in extensive superficial vascular lesions and bleeding can be prevented in the removal of superficial angiomata by the use of the Heidenhain suture.

The cautery knife may be of some aid in controlling capillary oozing and in causing lymphatic block during the removal of the tumor.

3. Epithelization can be accomplished over denuded bone by removal of the outer table and subsequent treatment of the granulating area with paraffin.

4. Angiomatous tumors may be associated with squamous-cell epitheliomata from progressive changes in the overlying hyperplastic epithelium. In such cases the angioma may be considered the indirect cause of the epithelioma.

5. Doubtful tumors should be sectioned for biopsy. If malignant they should be graded before operative procedures are completed or prognosis is stated.

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# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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Managing Editor  
Associate Editor

WILLIAM J. MAYO, M.D.

Chief of Editorial Staff

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### THE TOXEMIA OF ACUTE DUODENAL AND GASTRIC FISTULA

**I**N the cases of duodenal fistula reported by Colp, Cameron, Rigby, and others no explanation has been given for the associated toxæmia. Studies of the chemical changes in the blood accompanying acute clinical and experimental duodenal and experimental gastric fistula show that in all instances there is decreasing concentration of chlorides, progressive rise of urea, and a rising carbon dioxide combining power of the blood plasma. In cases of experimental acute gastric fistula there is greater increase in the carbon dioxide combining power of the plasma than in cases of duodenal fistula due to the greater loss of acid from the body through the fistula. The decrease in the chloride content of the blood is quite comparable to that found in cases of high intestinal stasis by Brown, Eusterman, Hartman, and Rowntree, and by Haden, Orr, and McVicar. Haden and Orr showed that the nearer the obstruction to the pylorus of the stomach the greater the toxæmia; this might be explained on the hypothesis that the

loss of chlorides from the blood and tissues in such cases was due to their excretion into the lumen of the intestine, whereas in cases of experimental gastric fistula the chlorides were lost from the body by excretion through the fistula. In experimental acute gastric fistula as in acute duodenal fistula, the part played by interruption in the continuity of the gastrointestinal tract by the fistula must also be considered.

It has been possible to control the toxæmia accompanying acute duodenal and gastric fistula by intravenous injections of isotonic sodium chloride solution. Fluid balance seems to play an important part for these injections in concentrated solution even if in sufficient amount to raise the blood chlorides to normal have practically no effect in lengthening the life of animals with duodenal fistula. If however a sufficient volume of water is added to the sodium chloride and this solution given twice daily life may be maintained for 3 weeks or longer during which time the blood chlorides are not only raised to their normal level but non-protein nitrogen is prevented from accumulating in the blood. Intravenous injections of isotonic glucose solution and sodium sulphate solutions although they assist in the elimination of the non-protein nitrogen retained in the blood have no effect on the blood chlorides and the dogs die as quickly as though no intravenous injections had been given. The amount of nitrogen lost in the urine and in the fistulous fluids is increased somewhat above the normal level (although there is definite evidence of retention of nitrogen) until just before death when



a decrease in the excretion of nitrogen compounds in urine.

To determine the effect of loss of bile and pancreatic secretion through a duodenal fistula the common bile duct and both pancreatic ducts have been transplanted into the jejunum of two dogs as a consequence of which neither the bile nor the pancreatic secretions are lost through the duodenal fistula. These dogs show the same chemical changes in the blood as the dogs with duodenal fistula the ducts of which have not been transplanted.

The intravenous injection of large quantities of the physiological solution of sodium chloride to control the toxemia accompanying acute gastric and duodenal fistula combined with the suction method of Erdman, Cameron and Lahey for removing the fistulous fluid and thus preventing digestion and absorption of the proteins of the skin should be first tried in the treatment of all such fistulae. Glucose can be added to the solution of sodium chloride if necessary in order to supply the patient with calories for heat and energy. Should the fistula be large and fail to heal operation can be more safely performed because of the control of the associated toxemia of the acute fistula by the intravenous injection of sodium chloride solution.

W. LITMAN WALTERS

## PHYSICAL EXAMINATION OF PATIENTS WITH OCULAR DISEASE

FOR many years syphilis and tuberculosis have been the catchalls in which has been thrown the blame for inflammatory diseases of the eye that could not definitely be ascribed to some other cause. Pathologists have at times added to the clinician's confusion by ascribing to syphilis

inflammatory processes in the orbit of bacterial origin in a large number of all clinical and pathological diseases. The presence of the disease of syphilis or a positive Wassermann reaction is almost sure to mask any other facts that may be present.

Any inflammatory lesion of the orbit about the eye that is treated by the use of mercury and iodine is almost always being due to syphilis. While it is not possible definitely to exclude syphilis, it should be borne in mind that mere syphilis is not an effective therapeutic agent in such conditions.

Even when tuberculous etiology is remote from the eye is discovered and if no sign of the disease was elsewhere in the body and tuberculin was administered as a diagnostic test there is little grounds for ascribing tuberculosis as the cause of major or minor lesions of the eye in the absence of any other clinical manifestations of the disease. Since the advent of foreign body therapy the tuberculin test has lost some of the significance formerly attributed to it.

The relationship between inflammatory disease of the eye and focal infection has been clearly demonstrated in series of cases in which careful examination and observation have been made. The evaluation of foci of infection as etiological agents is gradually being established in the minds of those who are thoroughly investigating a sufficient number of cases. The most serious impediment to the realization of the rôle of focal infection is the incomplete search for foci in the physical examination. Another fault lies in the failure of the examining physician to realize that a small area of infection giving no local disturbance could be held to account for active inflammation elsewhere in the body. A certain ophthalmologist's judgment of focal

infection is based on the attitude of a dentist friend who insists on keeping a devitalized tooth which he knows has been abscessed at the root for many years because it causes no local disturbance and because his general health is good.

Hundreds of patients have been subjected to nasal operations and tonsillectomy and dental extractions before complete examinations have been made in an effort to clear the body of infection.

Although the teeth and tonsils are the most common foci of infection numerous cases are reported in which there is infection in the pelvic organs in the appendix and in the gall bladder, showing quite clearly that infectious areas may be far from the eye yet intimately

connected with the origin and course of the disease of the eye. A physical examination designed to reveal the cause of inflammatory disease of the eye is not complete until reasonable attention has been given to the genital organs as possible sources of infection and a local therapeutic regimen established. The importance of infection of these organs in cases of iritis and episcleritis is established. The examining physician must recognize this fact and consider the cervix and the prostate as possible foci of infection equal in importance to the tonsils and teeth, so far as disease of the eye is concerned. The ophthalmologist owes it to himself and to his patient to insist that the patient shall be thoroughly examined.

WILLIAM L. BENEDICT

a decrease in the excretion of nitrogen accompanied anuria

To determine the effect of loss of bile and pancreatic secretion through a duodenal fistula the common bile duct and both pancreatic ducts have been transplanted into the jejunum of two dogs, as a consequence of which neither the bile nor the pancreatic secretions are lost through the duodenal fistula. These dogs show the same chemical changes in the blood as the dogs with duodenal fistula the ducts of which have not been transplanted.

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WALTMAN WALTERS

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inflammatory processes in the tissues of the orbit of uncertain origin, even in the absence of all clinical and biochemical evidence of that disease. The presence of clinical signs of syphilis or a positive Wassermann reaction is almost sure to mask any other etiological factor that may be present.

Any inflammatory lesion of the eye or any swelling about the orbit that is reduced by the use of mercury and iodides is suspected of being due to syphilis. While it may be impossible definitely to exclude syphilis it should be borne in mind that mercury and iodides are effective therapeutic agents for many other conditions.

Even when tuberculosis of some organ remote from the eye is discovered at necropsy if no sign of the disease was elicited during life and tuberculin was administered as a diagnostic test, there is little grounds for ascribing tuberculosis as the cause of minor inflammatory lesions of the eye in the absence of any other clinical manifestations of the disease. Since the advent of foreign protein therapy the tuberculin test has lost some of the significance formerly attributed to it.

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NATHAN RYNO SMITH  
1797-1877

# MASTER SURGEONS OF AMERICA

## NATHAN RYNO SMITH

**A**MONG the outstanding figures in the American medical world during the middle period of the last century, Nathan Ryno Smith will always occupy a conspicuous position. He was born in Cornish, New Hampshire on May 21, 1797, being the second son of an illustrious father. Dr. Nathan Smith, professor of medicine and surgery in the Medical School of Yale College.

Dr. Nathan R. Smith received his classical education at Yale, from which institution he graduated in 1817 with the degree of bachelor of arts. He also pursued his medical studies at Yale College and received the degree of doctor of medicine there in 1823. Following his graduation he settled at Burlington, Vermont in 1824 and began to practice his profession. In 1825 in conjunction with his father he organized the Medical School of the University of Vermont and was appointed its first professor of anatomy and surgery. Feeling the need of further instruction in order to fit himself for the position of a teacher he spent the winter of 1825-1826 in Philadelphia in attendance on the lectures at the University of Pennsylvania. While in that city he became associated with Dr. George McClellan and others in organizing the Jefferson Medical College and was elected to the professorship of anatomy, which chair he filled during two sessions. Among his pupils at Jefferson Medical College were Samuel Gross, subsequently professor of surgery in the same institution and for many years considered the Nestor of American surgery, and Washington L. Atlee a renowned ovariotomist.

In 1827 he was called to Baltimore as professor of anatomy in the University of Maryland, but after a short while he was transferred to the chair of surgery—a position that he held except for a brief intermission for over 40 years. He found Baltimore a ripe field for surgical practice and so thoroughly did he dominate surgical thought and work in that city and the state of Maryland that he became known widely as the "Emperor" and to this day those of his pupils who are still living cling to this title in affectionate remembrance of their distinguished master. At the time of his removal to Baltimore he was about 30 years of age and he continued to reside there until his death in 1877. Owing to dissensions between the trustees and the faculty of the University of Maryland in 1838 Dr. Smith accepted the chair of practice of medicine in Transylvania

University at Lexington Kentucky and for three sessions he traveled to and fro to fulfill the duties of his position. He delivered some lectures during this time at the University of Maryland also and upon the readjustment of the affairs at this institution he resumed the professorship of surgery in 1840 and continued his courses of instruction until 1870 when advancing years and physical infirmities impelled him to relinquish active participation in the work of the medical school and to retire with the rank of emeritus professor of surgery. As late as 1873-1874 he held occasional clinics at the University Hospital and the writer remembers attending one in which he said "Anybody can do good work with good tools but it takes a surgeon to do good work with poor tools" and as an illustration he mentioned that on one occasion while he was on a railroad train a man was injured to such an extent that an amputation became necessary. The man was placed in the baggage car and an operating table improvised. Dr Smith did not have any amputating instruments with him but with a butcher's knife and a carpenter's saw the leg was amputated and the stump was dressed before he reached the city. This was before the era of anti septic and aseptic surgery and I do not remember that he stated the result of the operation. On another occasion he said he had been called to see a highly nervous boy suffering with a large abscess of the thigh. To allay the patient's apprehension he was introduced as Cousin John and he suggested that he be allowed to look at the inflamed spot. When he had seen it he said he thought it would soothe it if he washed and shaved it and asked if he could have a razor. The razor was brought and he proceeded to shave the area but after making a few passes he turned the edge of the razor down and made the required incision. The boy with a scream said "You are not Cousin John. You are the old devil. Your name is Smith." Cordell the medical historian says Professor Smith was a man of commanding presence fully 6 feet in height with clean shaven face a well shaped Grecian nose long thin compressed lips piercing eyes surrounded by shaggy eyebrows, a well poised head and a long neck concealed by an old fashioned black stock and standing collar. He was near sighted and wore glasses. He lectured without notes in slow deliberate fashion in a voice of medium pitch, distinct though not strong.

He was an indefatigable worker and was accustomed to make his rounds at the Baltimore Infirmary, now the University Hospital about 6 30 o'clock in the morning on which he was accompanied by his residents and students. Whilst his surgical work was varied and extensive his reputation rests chiefly on his lithotome an instrument for the performance of vesical lithotomy and the anterior splint. It is said that he operated for stone in the bladder about 350 times with a very low mortality a large portion of his success as well as that of his son Dr Alan F Smith in these operations being due to the use of this lithotome. Dr Smith's lithotome was an ingenious but simple instrument for the







performance of perineal lithotomy, by means of which the extraction of calculi from the urinary bladder was rendered easy and safe. A distinguished professor of Surgery is said to have remarked, "With it anyone could operate. The anterior splint for the treatment of fractures of the lower extremities was a great improvement on the methods in vogue at that time, and was considered by Professor Smith to have been his chief contribution to surgery. This suspensory apparatus has now fallen into undeserved disuse and is as capable of rendering good service now as it was when perfected by him in 1860. The principle upon which this was based was that of the double inclined plane with suspension. During the Civil War the anterior splint was used with the greatest benefit and comfort in the treatment of soldiers suffering from compound gunshot fractures of the lower extremities. The Hodgen splint, which is used satisfactorily in some parts of this country is merely a modification of Smith's anterior splint and the usefulness of both of these appliances is due to the fact that the limb can be swung and a certain amount of motion permitted without interfering with the healing process. The same principles were applied in the treatment of fractures in the late World War, but with greater provision for extension than was possible with the original anterior splint.

As early as 1835 Dr. Smith performed a complete thyroidectomy for a large ulcerating tumor of the thyroid body without anesthesia and with no artery forceps nor other appropriate methods of hæmorrhage. The patient survived for 13 days and died with symptoms of pyæmia. The late Professor Halsted says "Nathan R. Smith had quite surely never seen an operation performed on the thyroid gland and it is not unlikely that he had never heard of such an operation. My admiration for Dr. Smith Baltimore's Emperor has been greatly increased since reading his modest and lucid report of a case the importance of which he could hardly have comprehended. Dr. Halsted considers this operation to have been the chief *deu re* of Nathan R. Smith. The late Professor Samuel D. Gross says "Dr. Smith was one of the most distinguished surgeons that our country has produced. As a mechanical surgeon he has justly occupied a high rank.

Dr. Smith was a frequent contributor to surgical literature and was the author of several books, the most important of which are *Memoirs Medical and Surgical, of Dr. Nathan Smith* with additions by the author 1831 *Surgical Anatomy of the Arteries* 1830 *Fractures of the Lower Extremity and Use of Suspensory Apparatus* 1867 and *Legends of the South* 1869. He received the degree of doctor of laws from Princeton College in 1852. In 1861, when he was 70 years of age he made his first and only visit to Europe and was received with great distinction by the leading surgeons of Great Britain and the Continent and on his return to this country he was the recipient of a great ovation from his friends and admirers. He continued to meet his classes for 2 years longer and then retired from his chair.

RANDOLPH WINSLOW

